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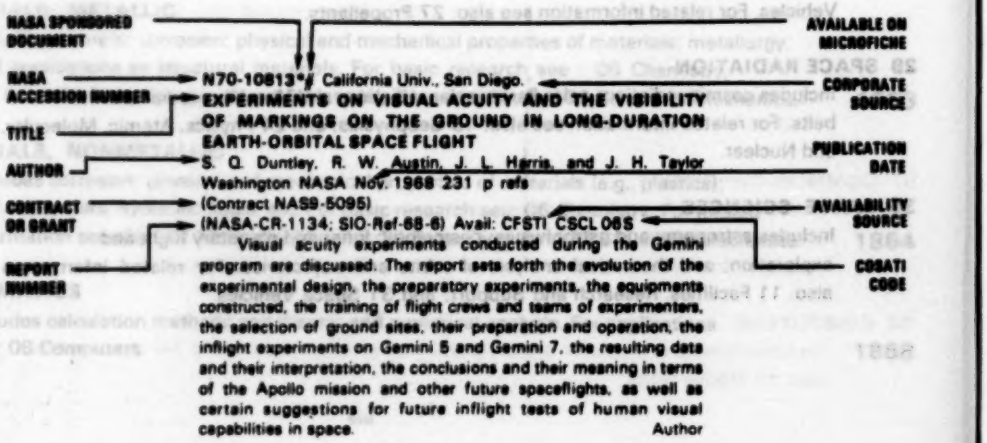
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AUTHOR
S. Q. Duntley, R. W. Austin, J. L. Harris, and J. H. Taylor
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COSATI CODE
Visual acuity experiments conducted during the Gemini program are discussed. The report sets forth the evolution of the experimental design, the preparatory experiments, the equipments constructed, the training of flight crews and teams of experimenters, the selection of ground sites, their preparation and operation, the inflight experiments on Gemini 5 and Gemini 7, the resulting data and their interpretation, the conclusions and their meaning in terms of the Apollo mission and other future spaceflights, as well as certain suggestions for future inflight tests of human visual capabilities in space.
Author

VOLUME 8 NUMBER 10 / MAY 23, 1970

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N70-22563# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

EFFECT OF AIRFOIL SHADE ON THE AERODYNAMIC CHARACTERISTICS OF A WING NEAR A GROUND-PLATE SURFACE

A. I. Yukhimenko 18 Sep. 1969 15 p refs Transl. into ENGLISH from Gidrodinamika Bolshikh Skorostei, (USSR), no. 2, 1966 p 34–46

(Contract NOw-62-0604-C)

(AD-697900; APL-CLB-3-T-603) Avail: CFSTI CSCL 1/3

Considered is the two-dimensional problem of motion of a slender wing in a potential fluid flow at small distances from a solid ground-plate, which corresponds to the case of high-speed motion of a wing above the interface between two fluids of different density. The problem is solved under the assumption that the fluid is ideal and incompressible, the motion outside the wing is potential, the wing is slender, and the angles of attack are small. Author (TAB)

N70-22630# ARO, Inc., Arnold Air Force Station, Tenn.

MEASUREMENTS AND CORRELATIONS OF TRANSITION REYNOLDS NUMBERS ON SHARP SLENDER CONES AT HIGH SPEEDS Final Report, 30 Jul. - 26 Sep. 1968.

S. R. Pate AECD Dec. 1969 58 p refs

(Contract F40600-69-C-0001)

(AD-698326; AEDC-TR-69-172) Avail: CFSTI CSCL 20/4

An experimental investigation of laminar boundary-layer transition on a sharp, 10-deg total-angle, insulated cone at zero yaw was conducted in 12- and 40-in. supersonic wind tunnels at free-stream Mach numbers from 3 to 6. This research was directed toward defining the relationship between the aerodynamic noise disturbances and boundary-layer transition Reynolds numbers in high-speed wind tunnels and extended previously published planar results to include axisymmetric models. A significant increase in the Reynolds numbers with increasing tunnel size (similar to the planar results) is shown to exist. Sharp cone transition Reynolds numbers from ten facilities (12- to 54-in.) for free-stream Mach numbers from 3 to 14 and a unit Reynolds number per inch range from 100,000 to 1,200,000 were correlated using aerodynamic-noise-transition parameters. A quantitative correlation of the ratio between cone and planar Reynolds numbers values was developed which demonstrates a strong Mach number dependence and also indicates a variation with tunnel size and unit Reynolds number. Author (TAB)

N70-22633*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

INDUCED INTERFERENCE EFFECTS ON THE AERODYNAMIC CHARACTERISTICS OF A 0.18-SCALE SIX-JET V/STOL MODEL IN TRANSITION

Matthew M. Winston Washington Mar. 1970 74 p refs

(NASA-TN-D-5727; L-6921) CSCL 01A

Tests were conducted in the 17-foot (5.18-meter) test section of the Langley 300-MPH 7- by 10-foot tunnel. The model was powered by six cold-air ejectors simulating four direct-lift and two lift-cruise jet engines. The jet-induced interference effects are analyzed for the pure-lift and lift-cruise propulsion modes for effective velocity ratios from 0 to about 0.12 over ranges of angle of attack and sideslip angle. The effects of horizontal-tail configuration, thrust vectoring, and ground proximity are examined. Results of a limited investigation of the inlet-mass-flow contribution to the total induced effects are included. Author

N70-22634*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

JET EFFECTS ON THE BOATTAIL AXIAL FORCE OF CONICAL AFTERBODIES AT SUBSONIC AND TRANSONIC SPEEDS

William B. Compton, III and Jack F. Runckel Washington Feb. 1970 110 p refs

(NASA-TM-X-1980; L-6730) Avail: CFSTI CSCL 01A

A parametric investigation has been conducted to determine the jet effects on the boattail axial force of nozzles having truncated conical afterbodies. The boattail axial force for nozzle configurations having boattail angles of 3 deg, 5 deg, 10 deg, and 15 deg and having ratios of boattail length to maximum diameter of 1.0, 0.8, and 0.6 was compared for the jet-off condition and for a wide range of jet pressure ratios. A nozzle configuration with a boattail angle of 7.5 deg, one with a boattail angle of 20 deg, and one with a circular-arc boattail were tested also. The tests were run at an angle of attack of 0 deg and through a Mach number range of 0.30 to 1.30. Author

N70-22670 Catholic Univ. of America, Washington, D.C.

MINIMUM ENERGY HYPERSONIC NOSE AND LEADING EDGE SHAPES

Roger Joseph Furey (Ph.D. Thesis) 1969 65 p

Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19920

A system of first-order differential equations governing the heat transfer (convection and shock layer radiation) and pressure drag of an axisymmetric or two-dimensional body in hypersonic flow is developed. The Pontryagin Maximum Principle, through the gradient method is applied to this system and a series of optimum hypersonic nose and two-dimensional shapes of given fineness ratio is found. The optimum shapes having minimum drag, minimum heat transfer (convection), minimum heat transfer (radiation) and minimum energy are determined. The axisymmetric minimum drag shape is found to be similar to the 3/4 power law profile already established as the minimum drag hypersonic nose shape while the

two-dimensional result is a wedge shape. The minimum heat transfer (convection) profile, both two-dimensional and axisymmetric, is found to be flat faced with a larger expanse of flatness in the axisymmetric case. Dissert. Abstr.

N70-22671 Catholic Univ. of America, Washington, D.C.
AN ANALYSIS OF THE COMPRESSIBLE LAMINAR BOUNDARY LAYER ON A HIGHLY YAWED CONE WITH HEAT TRANSFER
Russell Aubrey Smith (Ph.D. Thesis) 1969 174 p
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An approximate integral method is applied to the three-dimensional laminar boundary layer equations, including the energy equation for Prandtl number equal to unity, to obtain a solution to the attached boundary layer on slender cones in hypersonic flight at high angles of attack. The velocity and total enthalpy profiles are of the Timman type. The crossflow velocity profile is a two parameter family allowing for non-zero crossflow at streamline inflection points. Because of the high angles of attack considered, the solution includes the effect of large crossflow on the boundary layer. Using pressure data available in the literature, results for heat transfer coefficient, surface shear stress direction, and position of separation are computed. The computations compare favorably with data from the literature. Dissert. Abstr.

N70-22748 Polytechnic Inst. of Brooklyn, N.Y.
THE LAMINAR BOUNDARY LAYER ON A CONE AT INCIDENCE IN SUPERSONIC FLOW
Ralph Rensselaer Boericke (Ph.D. Thesis) 1969 175 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-20318

The results are described of a numerical investigation of the laminar boundary layer equations for a cone at angle of attack on a supersonic flow. The equations are reduced from three independent variables to two, by the use of a similarity transformation. A further transformation is made to remove a singularity at the leeward symmetry plane. The reduced equations are solved with an implicit finite difference technique by marching from the windward to the leeward symmetry planes. Several cases were computed to test a hypothesis, that an indeterminacy of the ordinary differential equations applicable on the leeward symmetry plane was due to a violation of the region of influence. It is shown that where a leeward symmetry plane solution was obtained with the present technique, the same solution can also be obtained from the ordinary differential equations. Dissert. Abstr.

N70-22790# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
PROCEEDINGS OF THE THIRD CAL/AVLABS SYMPOSIUM. AERODYNAMICS OF ROTARY WING AND V/STOL AIRCRAFT. VOLUME 1: ROTOR/PROPELLER AERODYNAMICS AND ROTOR NOISE
1969 271 p refs Held at Buffalo, 18–20 Jun. 1969 Sponsored in part by US Army Aviation Materiel Labs.
(AD-693246) Avail: CFSTI CSCL 1/3

Contents: A continuous vortex sheet representation of deformed wakes of hovering propellers; Propeller wake deformation due to instability of a trailing vortex sheet; Vortex field, tip vortex, and shock formation on a model propeller; An experimental investigation of an oscillating two-dimensional airfoil in reverse flow; Design of airfoils for rotors; A hover performance analysis combining the strip-momentum and prescribed wake theories; Helicopter rotor noise generation; The importance of vortex shedding effects on helicopter rotor noise with and without blade slap; Prediction methods and trends for helicopter rotor noise; and Rotor noise measurements in wind tunnels. TAB

N70-22791# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
PROCEEDINGS OF THE THIRD CAL/AVLABS SYMPOSIUM. AERODYNAMICS OF ROTARY WING AND V/STOL AIRCRAFT. VOLUME 2: WIND TUNNEL TESTING, NEW CONCEPTS IN ROTOR CONTROL
1969 318 p Held at Buffalo, 18–20 Jun. 1969 Sponsored in part by US Army Aviation Materiel Labs.
(AD-693247) Avail: CFSTI CSCL 1/3

Contents: Model vs. full scale rotor testing; The flow throughout a wind tunnel containing a rotor with a sharply deflected wake; Comments on V/STOL wind tunnel data at low forward speeds; Problems associated with tunnel tests of high disk loading systems at low forward speeds; Some research on rotor circulation control; The aerodynamics of a circulation-controlled rotor; Higher harmonic pitch control; and The controllable twist rotor. TAB

N70-22792# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
PROCEEDINGS OF THE THIRD CAL/AVLABS SYMPOSIUM. AERODYNAMICS OF ROTARY WING AND V/STOL AIRCRAFT. VOLUME 3: FEATURED SPEAKERS AND PANEL SESSION ON RECOMMENDATIONS FOR FUTURE AERODYNAMIC RESEARCH
1969 148 p refs Held at Buffalo, 18–20 Jun. 1969 Sponsored in part by US Army Aviation Materiel Labs.
(AD-693248) Avail: CFSTI CSCL 1/3

Contents: Welcome by host organizations; Keynote address; Now is the time for aerodynamics to come to the aid of the hardware; Recommendations for future aerodynamic research; Notes on rotor aerodynamic research; Suggestions toward a coordinated approach to aerodynamic research; Future aerodynamic research; Aerodynamic research related to propeller driven V/STOL aircraft; Panel discussion--question and answer period; and Some problems in the numerical solution of vortex motion equations. TAB

N70-22842*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development.
SINGLE STAGE EXPERIMENTAL EVALUATION OF COMPRESSOR BLADING WITH SLOTS AND VORTEX GENERATORS. PART 2: DATA AND PERFORMANCE FOR STAGE 5 WITHOUT SLOTS OR VORTEX GENERATORS
J. A. Brent and B. A. Jones 20 Mar. 1970 108 p refs
(Contract NAS3-10481)
(NASA-CR-72634; PWA-FR-3481) Avail: CFSTI CSCL 01A

Stage 5 of a series of highly-loaded slotted stages was tested without slots or vortex generators to establish a performance baseline for comparison with the results of subsequent tests planned with the addition of slots and vortex generators. Failure of the rotor due to bending flutter at high negative incidence angles precluded the latter series of tests. The rotor had an inlet hub/tip ratio of 0.8 and a design tip velocity of 757 feet per second. At design equivalent rotor speed, the rotor achieved a maximum efficiency of approximately 84% and a corresponding pressure ratio of 1.365. High stator losses resulted in substantially lower stage performance. Author

N70-22844# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
BINARY FLUTTER CALCULATIONS WITH THEORETICAL AND EMPIRICAL AERODYNAMIC DERIVATIVES FOR A WING-CONTROL SURFACE SYSTEM IN TWO-DIMENSIONAL INCOMPRESSIBLE FLOW
H. Bergh and H. Tijdeman Aug. 1969 21 p refs Submitted for publication Sponsored by Neth. Aircraft Develop. Board
(NLR-TR-68069-U) Avail: CFSTI

A number of comparative flutter calculations for a two dimensional wing-control surface system has been performed to demonstrate the usefulness of empirical formulas for the control surface derivatives. Furthermore, attention has been paid to the influence of the chord ratio tau on the flutter behaviour and to the sensitivity of the system to each of the aerodynamic derivatives. Author (ESRO)

N70-22875# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
STATIONARY AND INSTATIONARY PRESSURE AND FORCE MEASUREMENTS ON A CIRCULAR CYLINDER AT REYNOLDS NUMBER UP TO 7.7 TIMES 10 SUP 6

J. W. G. van Nunen and P. Schippers 11 Nov. 1969 123 p refs Sponsored by ELDO
(NLR-TR-69101-U) Avail: CFSTI

Wind tunnel tests were carried out on a circular cylinder with its longitudinal axis perpendicular to the flow. The investigation, in which the Reynolds number ranged from about 0.5 to 7.7 million, consisted of the measurement of stationary and non-stationary pressure distributions while the model was held fixed and the determination of the overall stationary and non-stationary forces and moments while the model was let free to oscillate. The results of the measurements are presented together with a description of the tests. Author (ESRO)

N70-22877# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
EXAMPLES OF RESEARCH ON AIRFOILS IN THE TWO-DIMENSIONAL SUBSONIC S-10 WIND TUNNEL OF CEAT, TOULOUSE [EXEMPLES DE RECHERCHES SUR LES PROFILS DANS LA SOUFFLERIE S-10 DU CEAT, A TOULOUSE]
Émile Erlich 1969 16 p refs In FRENCH; ENGLISH summary Presented at the 6th Assoc. Franc. des Ingr. et Techniciens de L'Aeron. et de L'Espace Colloq. on Applied Aerodyn., Toulouse, 12–14 Nov. 1969 Submitted for publication
(ONERA-TP-766) Avail: CFSTI

Results on an airfoil calculated for transonic flight and an airfoil equipped with high lift devices are presented; the combined effects of viscosity and compressibility are evident as well as the necessity of analyzing in detail the flow around the leading edge in a study of stall. Such a study now appears possible, due to the full-scale leading edge technique in which it is possible to simulate the flight conditions. Author (ESRO)

N70-22949# National Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands)
SYMMETRICAL TRANSONIC POTENTIAL FLOWS AROUND QUASI-ELLIPTICAL AEROFOIL SECTIONS
M. I. Baurdoux and J. W. Boerstoel Dec. 1968 18 p refs Submitted for publication
(NLR-TR-69007-U) Avail: CFSTI

The results of the computation of ten symmetrical non-lifting quasi-elliptical aerofoil sections in transonic potential flows are presented. No approximations have been made in the potential theory. Results are summarized in figures and tables. The fibures permit a rapid appraisal of the overall properties. More detailed information is given in the tables.The precision of the given data in the tables is a few units of the last decimal place specified. The data can serve as a reference for the testing of (approximate) computation methods for transonic flows. Author (ESRO)

N70-23103*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SHOCK WAVE SHAPES AND SURFACE PRESSURES ON HEMISPHERE AND CONE CYLINDERS IN LOW DENSITY HYPERSONIC FLOW INCLUDING ABLATION
Daryl J. Monson and Donald M. Kuehn Washington Apr. 1970 17 p refs
(NASA-TN-D-5721; A-3499) Avail: CFSTI CSCL 01A

Shock wave shapes and surface pressures were determined in air for highly cooled hemisphere- and cone-cylinders with and without ablating noses. The test Mach number was 14. The test Reynolds numbers of 9000 and 1000, based on the cylinder diameter, were estimated to be in the boundary layer and merged layer flow regimes, respectively. Comparisons with the predictions of viscous-interaction theory have been made and the range of validity for the theory has been assessed. The results show that in the merged layer regime viscous interaction theory can predict the shock wave shapes for these bodies but fails to predict the surface pressures on the bodies. With merging, the surface pressures on the hemisphere-cylinder decreased below the predicted inviscid pressures. The behavior of the shock waves and surface pressures for these bodies in the merged layer regime is qualitatively the same as that previously observed for sharp bodies. Nose ablation displaced the shock waves outward and increased the surface pressures on the bodies for a short distance behind the noses. These trends were qualitatively predicted by viscous interaction theory. Author

N70-23108*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LARGE-SCALE WIND-TUNNEL TESTS OF AN AIRPLANE MODEL WITH FOUR PROPELLERS AND ROTATING CYLINDER FLAPS Technical Note
James A. Weiberg and Stanley O. Dickinson Washington Apr. 1970 71 p refs
(NASA-TN-D-5742; A-2769) Avail: CFSTI CSCL 01A

Wind tunnel tests were made of a model equipped with rotating cylindrical flaps and four propellers. Comparison with the results obtained with the same flap on a model with two propellers of larger diameter but with approximately the same slipstream coverage on the wing showed that large gains were obtained in the lift due to thrust and slipstream turning as a result of the increased flap chord relative to propeller diameter. The slipstream turning angles for the four propeller model were approximately equal to the flap deflection. Author

N70-23109*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW SUBSONIC AERODYNAMIC CHARACTERISTICS OF A MEDIUM HYPERSONIC L/D REENTRY SPACECRAFT WITH A VARIABLE GEOMETRY WING
John P. Decker and Bernard Spencer, Jr. Washington Apr. 1970 39 p refs
(NASA-TM-X-1998; L-6945) Avail: CFSTI CSCL 01A

A wind tunnel investigation was conducted at low subsonic Mach numbers between 0.21 and 0.41 and at Reynolds numbers based on body length from about 4.9×10 to the 6th power to 29.5×10 to the 6th power to determine the basic longitudinal aerodynamic characteristics of a variable geometry spacecraft having a hypersonic lift-drag ratio near 2. The configuration represents one approach to improving the subsonic lift-drag ratio of a lifting body by incorporation of severe afterbody boattailing to decrease the base drag and by the addition of an internally stowed variable sweep rigid wing. The model was tested with the wings deployed to 20 deg and 90 deg (stowed) at angles of attack from about −6 deg to 16 deg. Author

N70-23110*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
JET-PLUME-INDUCED FLOW SEPARATION ON A LIFTING ENTRY BODY AT MACH NUMBERS FROM 4.00 TO 6.00
Robert J. McGhee Washington Apr. 1970 30 p refs
(NASA-TM-X-1997; L-6980) Avail: CFSTI CSCL 20D

The investigation showed that increasing the ratio of jet-exit static pressure to free stream static pressure resulted in plume-induced boundary layer separation along the model lower surface and also resulted in an increase in the pressures in the separation region and a forward movement of the separation point. The pressure distributions obtained on the center line of the model showed characteristics of both laminar and transitional separation. Increasing the angle of attack resulted in a decrease in the extent of flow separation for all test Mach numbers; this result may partially be due to local Reynolds number changes. Two dimensional laminar separation theory resulted in reasonable correlation of the plateau pressure coefficients obtained on the center line of the model. Author

N70-23178# Leicester Univ. (England). Dept. of Engineering.
METHODS AND CONSEQUENCES OF ATMOSPHERIC BOUNDARY LAYER SIMULATION
David J. Cockrell and Brian E. Lee (Shell Res., Ltd.) *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 16 p refs (See N70-23165 10-20)
Avail: CFSTI

When wind tunnel testing models situations representative

of flow in the atmospheric boundary layer, mean velocity profiles must be simulated accurately. It is also desirable to reproduce the corresponding turbulence structure faithfully in all respects. Such reproduction calls for complete representation of the terrain upstream of the model situation. But blockage effects demand wind tunnels of large cross sectional area for this class of work, thus full representation of the mean and turbulent flow velocity is seldom practicable and compromises are necessary. The implications of such compromises are considered. Two basic methods of mean flow profile production are examined. These are using parallel cylinder grids having varying spacing and wedge-shaped, flow mixing devices. The extensive literature is reviewed so as to provide a guide to mean flow production for the practising aerodynamicist. An experimental programme is also surveyed in which the mean profiles produced by both methods in a rectangular-section duct at a Reynolds number of 300,000 are compared with those generated naturally in the same duct. Though a given mean velocity profile can be generated by more than one basic method, the corresponding turbulence distributions will be very different. In particular, the resulting Reynolds stress distributions can be very significant since these will cause modifications to the mean velocity profile. Author

N70-23179# Central Electricity Research Labs., Leatherhead (England). Engineering Sciences Div.

A METHOD OF SIMULATING A NEUTRAL ATMOSPHERIC BOUNDARY LAYER IN A WIND TUNNEL

J. Counihan *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 15 p refs (See N70-23165 10-20)

Avail: CFSTI

A method is described by which a neutral atmospheric boundary layer can be simulated in a wind tunnel. An accelerated rate of boundary layer growth was obtained by the use of vorticity generators in combination with a castellated barrier and surface roughness elements. The characteristics appropriate to rough wall boundary layer flow are apparent in the simulated flow at a distance of three boundary layer heights from the generator trailing edges: at a distance of four and a half boundary layer heights the flow was acceptably representative of true rough wall boundary layer flow. Extensive measurements were made in order to establish that the flow produced is reasonably uniform across the span of the wind tunnel and that it does not change appreciably in the streamwise direction. The variations with height of the simulated boundary layer properties were compared with data from natural and atmospheric boundary layers. The measured integral length scales of longitudinal turbulence were likewise compared with similar data. In all respects satisfactory agreement was obtained between the simulated boundary layer and the natural and atmospheric boundary layers. Author

N70-23181# Cambridge Univ. (England). Dept. of Engineering.

THE WAKE CHARACTERISTICS OF A BLUFF BODY IN A SHEAR FLOW

D. J. Maull *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 15 p refs (See N70-23165 10-20)

Avail: CFSTI

A method of producing a low turbulence shear flow in a wind tunnel is described. The shear flow had an almost linear velocity profile with the velocity near the roof of the tunnel about 50% greater than that near the floor. The turbulence level was about 0.5% based on the local mean velocity. Measurements were made of the wake of a flat plate normal to the flow direction and spanning the wind tunnel such that the velocity varied along the length of the plate. It was found that space correlations of the velocity fluctuations in the wake were significantly different when the plate was in a shear flow than when it was in a uniform stream. Spectra of the velocity fluctuations were measured at positions along the length of the plate in the shear flow and it was found that the Strouhal numbers, based on the local undisturbed free stream velocity, were approximately constant over about half the plate length. By comparing the signals from an array of hot wires behind the plate a model of the vortex shedding is postulated. Author

N70-23188# National Physical Lab., Teddington.

FLUCTUATING FORCE ON BLUFF BODIES IN TURBULENT FLOW

P. W. Bearman *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 15 p refs (See N70-23165 10-20)

Avail: CFSTI

An investigation into the effect of turbulence on the fluctuating drag forces experienced on a series of square plates set normal to a uniform turbulent flow is described. The experiments were performed as part of a research program to examine the influence of atmospheric turbulence on the response of flexible buildings and structures. Power spectral density measurements of the fluctuating component of the drag on square plates in turbulent flow are presented. The measurements show the importance of the ratio of turbulence scale to plate size. There is shown to be a strong correlation between the fluctuating drag force and the velocity fluctuations in the approaching flow. Measurements of aerodynamic admittance are presented to show the form of this function and to show how it varies with change of the ratio of turbulence scale to plate size. Finally, the effect of the body on the turbulence is considered and there is a discussion on how the turbulence is distorted as it is swept past a plate. Author

N70-23189# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

WIND EXCITED BEHAVIOUR OF CYLINDRICAL STRUCTURES: ITS RELEVANCE TO AEROSPACE DESIGN

D. J. Johns *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 16 p refs Supported in part by Min. of Tech. (See N70-23165 10-20)

Avail: CFSTI

A literature review is given of available data on the influence of ground winds on typical aerospace structures. Relevant data from non-aerospace studies are also discussed. Emphasis is placed on the wind induced excitation of circular, cylindrical shell structures in either the swaying (bending) or ovalling (breathing) modes and the relationships between these modal natural frequencies and the frequency spectrum of the aerodynamic input. The data on discrete vortex shedding in the subcritical and supercritical Reynolds number ranges is necessarily considered. The relevant structural vibration analyses to predict the natural frequencies of the stiffened and unstiffened shells are briefly outlined and certain deductions made on the efficacy of various types of stiffening. Consideration is also given to problems associated with complete lattice structures typical of launcher designs and with single component members of such structures. Author

N70-23190# Fiat S.P.A., Turin (Italy). Divisione Aviazioni.

STATISTICAL ANALYSIS OF GUST VELOCITIES FOR SPACE LAUNCHERS DESIGN

E. Albanese, F. Bevilacqua, and E. Vallerani *In* AGARD Aerodyn. Atmospheric Shear Flows Feb. 1970 15 p refs (See N70-23165 10-20)

Avail: CFSTI

The results of the studies performed for the definition of the design gust velocity to be adopted in the calculations of the lateral dynamic loads acting on the ELDO Vehicle during flight are presented. The problem of the gust is treated from a statistical point of view, defining a gust velocity not to be exceeded during all the flight, with a given probability of occurrence; on the basis of world wide statistical data of vertical gust velocities, the probability to encounter during a given flight trajectory a gust of assigned intensity was evaluated. The total probability is obtained through integration along an assigned trajectory of the frequency distribution components in which the turbulence was subdivided. The two dimensional gust velocity frequency distribution to be adopted in the design of space launch vehicles was derived from data relative to vertical gust measured by aircraft. The intensity of the gust which has a given probability to occur during an assumed trajectory is reported in a series of charts, that may be used both for the design and the prelaunch checks procedure of space launchers. Author

N70-23191# Aix-Marseilles Univ. (France). Inst. de Mecanique des Fluides.

AERODYNAMICS OF PERFORATED PLATES TO WIND BAFFLE DESIGN AND BEHAVIOR [AERODYNAMIQUE DES PAROIS PERFOREES: APPLICATION AU PROJET D'ECRANS DE PROTECTION CONTRE LE VENT; ETUDE DU FONCTIONNEMENT DE CES ECRANS]

Jacques Valensi and Jean Rebont *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 10 p refs (See N70-23165 10-20)

Avail: CFSTI

Aerodynamic and geometric porosity functions are theoretically calculated for the behavior of perforated plates to determine the optimal configuration for wind baffles. Low speed wind tunnel tests were performed to determine the characteristics of turbulent wakes at the lower part of a porous wall. The Euler equation is used to explain the velocity pertubations in the wakes. Emphasis is placed on the relationship between the aerodynamic porosity and the velocity domain. Transl. by J.M.C.

N70-23207# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC AERODYNAMIC CHARACTERISTICS OF A MEDIUM HYPERSONIC L/D REENTRY SPACECRAFT WITH A VARIABLE GEOMETRY WING

John P. Decker Washington Apr. 1970 87 p refs

(NASA-TM-X-1995; L-6939) Avail: CFSTI CSCL 01A

A wind-tunnel investigation was conducted at Mach numbers from 0.40 to 1.20 to determine the basic longitudinal and lateral-directional aerodynamic characteristics of a variable geometry spacecraft having a hypersonic lift-drag ratio near 2. The configuration represents one approach to improve the subsonic lift drag ratio of a lifting body by the incorporation of severe afterbody boattailing to decrease the base drag and by the addition of an internally stowed variable-sweep rigid wing. The model was tested with the wings deployed to 20 deg, 65 deg, 75 deg, and 90 deg (stowed) at angles of attack from about −6 deg to 16 deg and at angles of side slip of 0 deg and 5 deg. Author

N70-23342# Weapons Research Establishment, Salisbury (Australia).

A METHOD FOR DERIVING AERODYNAMIC FORCE AND MOMENT COEFFICIENTS FROM FREE FLIGHT DATA USING A COMPUTER PROGRAM

N. E. Gilbert Oct. 1969 82 p refs

(WRE-TN-HSA-157) Avail: CFSTI

A method is described for deriving aerodynamic force and moment coefficients from free flight data using a computer program. The method has been developed for investigations of bombs, or vehicles with two or four planes of symmetry, and comments on the analysis of data from instrumented bomb test vehicles are given. Dependence of the derived aerodynamic forces and moments upon incidence, roll orientation, and angular velocity is determined by using a least squares method to fit the flight data to a mathematical model of the force and moment system developed by Maple and Synge. The complete mathematical basis of the data processing is presented together with a detailed description of the application of the Maple and Synge theory. For bombs, the sources of free flight data and refinement of the data are discussed. The program is written in FORTRAN II for an IBM 7090 computer running under W.R.E. monitor and is designated IG2.27.1. A FORTRAN listing of the program and a description of the input and output are included. Author

N70-23373# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.

INFLUENCE OF THE TEST CHAMBER PRESSURE ON THE FLOW FIELD AROUND A MODEL IN THE HYPERSONIC WIND TUNNEL H1 [EINFLUSS DES MESSKAMMER-DRUCKES AUF DIE MODELLUMSTROEMUNG IN HYPER-SCHALLUINDKANAL H1]

Heinrich Pfeiffer and Erich Will Nov. 1969 24 p refs In GERMAN; ENGLISH summary

(DLR-FB-69-80) Avail: CFSTI

The influence of the test chamber pressure on the flow field around a model are described. The Mach number range of the tests was $7 < M < 11$ and the results are compared with flow field phenomena which occur in the supersonic regime ($M = 2$). Author (ESRO)

N70-23389# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.

NOISE MEASUREMENT OF FLOWS AROUND BODIES IN SUBSONIC WIND TUNNELS, PARK 2 [UEBER DIE GERAEUSCHMESSUNG AN UMSTROEMTEN KOERPERN IN UNTERSCHALLWINDKANAELEN, TEIL 2]

Gerhard Schulz Nov. 1969 36 p refs In GERMAN; ENGLISH summary Sponsored by Deut. Forsch. Gemeinschaft For Part 1 see N68-35997 22-01

(DLR-TB-69-86-Pt-2) Avail: CFSTI

Self-noise problems of subsonic wind tunnels with respect to sound measurements on models and ways of damping were given. Several noise damping installations were placed in the DFVLR-subsonic wind tunnel. The spatial distribution of the sound within the free-stream, as well as its dependence on the number of revolutions of the fan and on the free-stream velocity, were measured. The damping installations were successful, but still need to be completed. The tunnel self-noise was separated into its components, the fan noise and free-stream noise, by suitable evaluation methods. Author (ESRO)

N70-23401 Virginia Polytechnic Inst., Blacksburg.

A SIMILARITY SOLUTION FOR PLANAR ATMOSPHERIC REENTRY WITH AERODYNAMIC FORCE MODULATION

Fred William Martin (Ph.D. Thesis) 1969 122 p

Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-19977

The differential equations for planar motion describing reentry into a planetary atmosphere, with arbitrary lift and drag modulation functions, are written in the tangential and normal direction for the flight path. Broglio's power law approximation for the density, in an isothermal atmosphere, is used to write these equations in a nondimensional form that admits to self similar solutions with respect to body parameters. The independent variable, time, is transformed into a nondimensional density so that the governing equations can be expressed in terms of a small parameter. This operation yields a set of equations which are suitable for a nonsingular perturbation solution. Next, the governing equations of motion are written in a form which yields a less degenerate perturbation solution than the original form. A straightforward perturbation solution of these equations is shown to yield, in the limit, Picard's iteration solution which for nonskip trajectories leads to the unique solution. Dissert. Abstr.

N70-23492# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

LOW-SPEED WIND-TUNNEL TESTS OF A NUMBER OF FIN CONFIGURATIONS ON A FLAT-PLATE GOTHIC WING OF UNIT ASPECT RATIO

D. H. Peckham Aeron. Res. Council 1969 14 p ref Supersedes RAE-TR-68269; ARC-31080

(ARC-CP-1076; RAE-TR-68288; ARC-31080) Copyright. Avail: CFSTI

Results are given of six-component balance measurements on a gothic wing of unit aspect ratio fitted either with a pair of fins, at various spanwise locations, or a single central fin. Each fin was triangular in shape, with a leading-edge sweep of 60 degrees and an area 12.5% of that of the wing. Author (ESRO)

N70-23493# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

WALL CORRECTIONS TO LONGITUDINAL COMPONENTS MEASURED ON WIND-TUNNEL MODELS WITH TAILS

D. A. Lovell Aeron. Res. Council 1969 33 p refs Supersedes RAE-TR-68212; ARC-30826
(ARC-CP-1075; RAE-TR-68212; ARC-30826) Copyright. Avail: CFSTI

Calculations were made of the magnitude of the wall corrections to pitching moment for two models with tails. It is found that the first stage of approximation is accurate enough for values of lift coefficient up to four. For higher values of lift coefficient, it is suggested that it is not worth using the second approximations as the theory of wind tunnel wall-interference is not sufficiently accurate in its predictions for flows with the large values of downwash inherent in high-lift systems. The correction to lift calculated for the two models is shown to be nonnegligible, and it is recommended that it is applied in tests where differences are to be taken between tail-on and tail-off tests. Author (ESRO)

N70-23496# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
WIND TUNNEL TESTS ON SIX WING-BODY MODELS AT M = 4
J. Pike Aeron. Res Council 1969 30 p refs Supersedes RAE-TR-67196; ARC-2973
(ARC-CP-1074; RAE-67196; ARC-29730) Copyright. Avail: CFSTI

Force measurements and flow patterns for six models, with the same ogive-cylinder body and various wings, are presented for a free stream Mach number of 4. Five of the wings were unswept, and the sixth was a 65 deg delta. Values of C sub L, C sub m, and C sub D are compared for models of different wing section, aspect ratio, and taper ratio. They are also compared with values from the same models tested at lower Mach numbers. Author (ESRO)

N70-23550# Royal Aircraft Establishment, Farnsborough (England). Aerodynamics Dept.
DESIGN OF A SYMMETRICAL SECTION WITH SPECIFIED PRESSURE DISTRIBUTION
C. C. L. Sells Aeron. Res. Council 1969 21 p refs Supersedes RAE-TR-68109; ARC-30621
(ARC-(P-1049; RAE-TR-68109; ARC-30621) Copyright. Avail: CFSTI

A method for the calculation of the section thickness distribution to produce a given symmetrical pressure distribution near the critical Mach number is presented. By linearization about a known solution, obtained by Sells' program, a Neumann problem with the same field equations but a different boundary condition is established, and the computer solution of this problem forms one link in an iteration sequence. In the symmetrical case studied, the sequence converged to a slightly different solution from that sought. Attempts at solution of the lifting problem have been unsuccessful. Author (ESRO)

N70-23570# National Physical Lab., Teddington (England). Aerodynamics Div.
AERODYNAMIC FORCES AND MOMENTS ON MODELS OF TWO SECTIONS OF A FORTH CROSSING TOWER
C. F. Cowdrey Jun. 1969 17 p
(NPL-AERO-SR-027) Copyright. Avail: CFSTI

Results are given of measurements of the aerodynamic forces and moments on models of two sections of a crossing tower, for various angles of the incident wind, both in yaw and pitch. The results are expected to help in studies of structural failure of similar towers. Author (ESRO)

N70-23585# National Physical Lab., Teddington (England). Aerodynamics Div.
AN INVESTIGATION OF THE AERODYNAMIC STABILITY OF THE SPIRES FOR THE PROPOSED BRISTOL CATHEDRAL
L. R. Wootton and C. F. Cowdrey Jul. 1969 28 p
(NPL-AERO-SR-032) Copyright. Avail: CFSTI

The oscillations in wind of the triangular tower and the two four-sided fleches were studied using wind tunnel models. Vortex induced and galloping oscillations were observed, though, with the mass and damping representative of the full scale; the amplitudes were small. The largest amplitudes (about 1.0 inch, (25 mm)) occurred at about 90 mph (40 m/s) full scale with the flow normal to the axis of symmetry of the three towers. Author (ESRO)

N70-23586# National Physical Lab., Teddington (England). Aerodynamics Div.
THE AERODYNAMIC INVESTIGATION OF A PROPOSED DESIGN OF SUSPENDED STRUCTURE FOR THE MESSINA STRAITS BRIDGE
D. E. Walshe Jul. 1969 28 p refs
(NPL-AERO-SR-031) Copyright. Avail: CFSTI

The sectional model method was used to determine the aerodynamic stability characteristics of the proposed design of suspended structure. No serious instability was found within the range of wind speed expected at the site, but a classical flutter type instability was obtained in winds of 125 mph. The tests were extended to examine the aerodynamic behaviour of the structure as proposed but with spanwise slots in the centre and at the edge of the road deck. No classical flutter instability was then found but an instability with torsional motion occurred at the higher wind speeds; the amplitude increased with increase in wind speed. Author (ESRO)

N70-23588*# General Electric Co., Lynn, Mass. Aircraft Engine Group.
EXPERIMENTAL EVALUATION OF OUTER CASE BLOWING OR BLEEDING OF SINGLE STAGE AXIAL FLOW COMPRESSOR, PART 6 Final Report
C. C. Koch 30 Jan. 1970 86 p refs
(Contract NAS3-7618)
(NASA-CR-54592; GE-R69AEG256) CFSTI 20D

A high-aspect-ratio transonic rotor was tested with outer casing blowing and bleeding devices to determine if tip boundary layer control was an effective means of increasing the unstalled weight flow range of such a compressor with and without inlet flow distortions. Both blowing and bleeding over the rotor tip improved unstalled range; the blowing device was more effective than the bleed device. It was also determined that the porous outer casings used in this program improved the stall line even without use of blowing or bleeding flow for boundary layer control. Considerable data on performance with distorted inlet flows were also obtained for a plain casing configuration without boundary layer control. Author

N70-23631# National Physical Lab., Teddington (England). Aerodynamics Div.
MEASUREMENTS OF AERODYNAMIC FORCES ON THE NORTHUMBERLAND PARK TOWER
C. F. Cowdrey Jun. 1969 12 p ref
(NPL-AERO-SR-028) Copyright. Avail: CFSTI

Results are given of measurements of the aerodynamic forces, at various angles of yaw, on models of two sections of the lighting tower for the Northumberland Park depot of London Transport. Author (ESRO)

N70-23654# Politecnico di Torino (Italy). Inst. di Macchine e Motori per Aeromobili.
THEORETICAL EVALUATION OF AIR FLOW-RATE PENETRATING IN PRIMARY ZONE OF COMBUSTORS FOR GAS-TURBINES AND EXPERIMENTAL TESTS [VALUTAZIONE TEORICA DELLA PORTATA D'ARIA RICIRCOLANTE NELLA ZONA PRIMARIA DELLE CAMERE DI COMBUSTIONE PER TURBINE A GAS E VERIFICA SPERIMENTALE DEI RISULTATI OTTENUTI)
Leonello Verduzio and Paolo Campanaro Aug. 1968 44 p refs In ITALIAN; ENGLISH summary *Its* Publ. No. 101
Avail: CFSTI

A very simple theoretical model of the stabilization zone of a combustor with flame tubes is proposed in order to obtain the factors having influence on the air flow rate, which comes from

the stabilizing holes and penetrates in primary zone. Following the proposed theoretical model a calculation method to determine this flow rate approximately is proposed, and indications to use the method for combustor design are given. In order to give indications on the reability of the proposed calculation method, some preliminary experimental tests are shown. They are qualitatively in a good agreement with the theoretical results. Quantitatively, differences that sometimes are remarkable, are found. The causes to which these differences are due, are in doubt. Author

N70-23708# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.

SIMPLIFIED BASIC EQUATIONS AND SEMI-EMPIRICAL ANALYSIS OF LAMINAR BOUNDARY LAYER SEPARATION IN SUPERSONIC FLOW [ZUSAMMENSTELLUNG DER REDUZIERTEN GRUNDGLEICHUNGEN UND ANALYTISCH-EMPIRISCHEN BEZIEHUNGEN FUER DIE ABLOESUNG LAMINARER GRENZSCHICHTEN BEI UEBERSCHALLSTROEMUNG]

Hans-Peter Kabelitz Sep. 1969 36 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-70) Avail: CFSTI

Simplified differential equations for laminar boundary layer separation are deduced for various regimes of the Mach and Reynolds numbers. Analytic expressions, based on free interaction concepts, are derived for the wall pressure development in the separation region. As soon as detectable external pressure gradients occur in the separation region, apart from the separation self induced ones, the so-called Chapman analysis breaks down. An empirical estimate shows the influence of external pressure gradients on the separation pressure development. Author (ESRO)

N70-23723# Politecnico di Torino (Italy). Ist. di Macchine e Motori per Aerombili.

THE AIR RECIRCULATION RATIO IN CAN-TYPE GAS TURBINE COMBUSTION CHAMBERS

Leonello Verduzio and Paolo Campanaro Dec. 1968 28 p refs *Its* Publ. No. 107
Avail: CFSTI

A theoretical model is proposed by which it is possible to calculate with a good accuracy the percent of air mass flow which, issuing from the stabilization holes, flows in the primary zone; on the base of the same model, the parameters, which have an influence on the mentioned flow rate, are deduced. The analysis shows how one single parameter of correlation can be used for the comparison of flame tubes having different diameters and numbers of stabilization holes and with different diameters of the primary zone. Examined is the particular case of a combustion chamber without swirler and with jets entering the flametube at right angle to the tube axis. The analysis shows that at constant inlet conditions and with the same pressure drop across the flametube walls, the maximum air flow, entering the primary zone, is obtained with a particular value of the do/2Ro. When the number of holes is changed, the value of the maximum air flow recirculating changes, reaching its greatest value for n = 6 and $d(\phi/2Ro) = 0.17$. The comparison between the obtained experimental points and the theoretical results shows a very good agreement. Author

N70-23772# Oxford Univ. (England). Dept. of Engineering Science.

NUMERICAL SOLUTIONS OF HYPERSONIC NEAR-WAKE FLOW BY THE PARTICLE-IN-CELL METHOD

R. I. Crane London HMSO 1970 113 p refs Supersedes ARC-31265
(ARC-CP-1083; ARC-31205) Copyright. Avail: CFSTI

Theoretical solutions of near wake flow were obtained by application of the particle-in-cell numerical technique to hypersonic flow over the base of a cylindrical afterbody. Using the inviscid equations of motion and a uniform upstream flow, the flow angler after separation was found to be much smaller than experimental slender-body results suggested. However, the inclusion of a vertical layer representative of a boundary layer on the body resulted in a realistic wake flow pattern, although the lack of true viscosity was apparent in the profiles of flow properties. It is concluded that satisfactory near wake solutions might be obtained by the use of realistic viscosity terms throughout the flow field and of a much finer representation of the approaching boundary layer. Author (ESRO)

N70-23805# Fraunhofer Institut, Freiburg (West Germany).

FORMULAS AND TABLES ON THE MACH REFLECTION OF SHOCK WAVES (TRIPLE SHOCK THEORY) [FORMELN UND TABELLEN ZUR MACHSCHEN REFLEXION VON STOSSWELEN (DREISTOSSTHEORIE)]

H.-O. Amann and W. Heilig Oct. 1967 53 p refs In GERMAN
(Rept-1-68) Avail: CFSTI

The treatment of bow shock waves occurring in Mach reflection from simple bodies requires the use of the complicated methods of characteristics which can be simplified by assuming triple shock wave theory. This report contains formulas for the calculation of the limit angle of the double and triple shock theory and tables and graphs of numerical results. ESRO

N70-23810# Fraunhofer Institut, Freiburg (West Germany).

THEORY OF THE INTERACTION OF A WEAK SHOCK WAVE OR RAREFACTION SHOCK WITH THE ANISOTROPIC MIXING ZONE OF TWO PLANE SUPERSONIC FLOWS [THEORIE DER WECHSELWIRKUNG EINER SCHWACHEN STOSSWELLE ODER VERDUENNUNGSWELLE MIT DER ANISENTROPEN MISCHZONE ZWEIER EBNER UEBERSCHALLSTROEMUNGEN]

W. F. Merzkirch 1968 25 p refs In GERMAN
(Rept-2-68) Avail: CFSTI

Relations are derived for the interaction of a Mach wave with a layer of entropy discontinuity surfaces in a supersonic flow field. The intensity of the diffracted wave can be represented in closed form after suitable linearization and the results are compared with the numerical solution of the nonlinear equations. Several numerical examples were calculated for the mixture zone between two parallel, isentropic supersonic flows, in particular for the system of the reflected waves and the complete deflection of the external flow. ESRO

N70-23822# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

UNSTEADY MEASUREMENTS AND VISUALIZATION ON ROTORS [MESURES ET VISUALISATIONS INSTATIONNAIRES SUR LES ROTORS]

Henri Werle and Claude Armand 1969 28 p refs In FRENCH; ENGLISH summary Presented at the 6th Assoc. Franc. des Ingr. et Techniciens de l'Aeron. et de l'Espace Colloq. on Applied Aerodyn., Toulouse, 12—14 Nov. 1969 Submitted for publication
(ONERA-TP-777) Avail: CFSTI

Visualizations were obtained in the ONERA hydrodynamic tunnel and static tank in bi-dimensional flow (oscillating profile) and on rotors hovering or in translation; flow separation, wakes and vortices were observed in detail. These were checked in smoke tests on 4-metre diameter blades in the large sonic S-1 wind tunnel at Modane; fine pressure measurements were also made on the upper and lower blade surfaces. Author (ESRO)

N70-23832# Deutsche Forschungs- und Versuchsanstalt fuer Luft-und Raumfahrt, Goettingen (West Germany). Aero Dynsmische Versuchsanstalt.

UNSTEADY PRESSURE DISTRIBUTION MEASUREMENTS ON A HARMONICALLY OSCILLATING WING IN THE SUBSONIC AND TRANSONIC SPEED RANGE [INSTATIONAERE DRUCKVERTEILUNGSMESSUNGEN AN EINEM SCHWINGENDEN TRAGFLUEGEL IM SUBSONISCHEN UND TRANSSONISCHEN GESCHWINDIGKEITSBEREICH]

H. Triebstein Jul. 1969 31 p refs In GERMAN; ENGLISH

summary Presented at the DGLR Ann. Meeting, Bremen, 22–24 Sep. 1969
(AVA-FB-6913) Avail: CFSTI

Test equipment for the measurement of unsteady pressure distributions in the transonic wind tunnel (test section 1 × 1 m) and the relating test procedure are described. Some test results obtained in the speed range M = 0.5 to 1.2 for a rectangular wing performing pitching oscillations about different spanwise axes and control surface oscillations about the hinge axis are discussed. The experimental results were compared with theory and in the subsonic region good agreement was found, but in the transonic region considerable differences arise due to local shock waves and transonic buffeting. It is shown that the unsteady pressure amplitudes behave fairly linear with respect to the vibration amplitude as long as the angles of attack of the wing are relatively small. Author (ESRO)

N70-23878# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
REYNOLDS NUMBER AND MACH NUMBER EFFECTS ON THE MAXIMUM LIFT AND THE STALLING CHARACTERISTICS OF WINGS AT LOW SPEEDS
B. van den Berg 21 Mar. 1969 43 p refs
(NLR-TR-69025-U) Avail: CFSTI

A literature study was made of the effect of Reynolds number variations on wing stall. It appeared that large changes in maximum lift and type of stall may occur up to very high Reynolds numbers. The nature of these changes varies essentially for airfoils of different thickness and for moderately and highly swept wings. The Mach number effect was also investigated to a limited extent. It was found that appreciable compressibility effects may occur even at very low Mach numbers. Author (ESRO)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N70-22525# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
DETERMINATION OF THE DESIGN PARAMETERS FOR OPTIMUM HEAVILY LOADED DUCTED FANS Technical Report
Terry Wright (Ph.D. Thesis) Nov. 1969 15 p refs
(Contract DAHC04-68-C-0004)
(AD-697802; GIT-AER-69-3; AROD-T-2-8-E) Avail: CFSTI CSCL 1/3

A single-rotation ducted fan of highest induced efficiency is characterized by an ultimate wake vortex system shed from the blade trailing edges whose apparent motion is that of rigid helical surfaces. In addition and concentric with this inner sheet system there is a cylindrical surface of helical vortex filaments shed from the duct trailing edge. For zero hub diameter and neglecting compressibility, viscosity, and tip clearance, a consistent mathematical model of the constant-diameter vortex wake is developed and the compatibility relationships to be satisfied are presented. It is shown that the wake vorticity and the velocity distribution in the wake, for all loadings from the lightly loaded limit to the heavily loaded static thrust condition may be extracted from the lightly loaded result through the use of a simple algebraic scale factor. The performance parameters, thrust, power and blade bound vortex strength, are thus expressed in terms of a lightly loaded solution for a given freestream velocity, blade tip speed, blade number and the loading parameter. The lightly loaded case is compared to existing theoretical and experimental results. Some sample results for heavily loaded performance parameters and design parameters are presented and compared to the exact results for a heavily loaded ducted fan with an infinite number of blades. Results for the heavily loaded system over a broad range of conditions are presented. Author (TAB)

N70-22532# Air Vehicle Corp., San Diego, Calif.
WIND TUNNEL TESTS OF A FREE-WING TILT-PROPELLER V/STOL AIRPLANE MODEL Technical Report, Jun. 1968–Aug. 1969
T. Strand and E. S. Levinsky Oct. 1969 58 p refs
(Contract F33615-68-C-1672)
(AD-698355; AFFDL-TR-69-80; Rept-360) Avail: CFSTI CSCL 1/3

Wind tunnel tests were conducted on a free-wing tilt-propeller V/STOL airplane model to investigate the aerodynamic characteristics of the free-floating wing in the propeller slipstream through the transitional region from cruise to near hover. Lift and drag curves wing-free were obtained as a function of propeller tilt angle and thrust coefficient, and are compared with wing-pinned data. The results indicate that the tilted propeller does not significantly turn the flow past the wing, except at thrust coefficients near unity and at propeller tilt angles near 90 deg. It is found that lift curve slope and maximum lift coefficient are strong functions of thrust coefficient. Provided the cruise static margin is adequate, the free-floating wing with flap and slat retracted behaves in the slipstream with no unusual problems. Based upon these initial test results, the free-wing concept therefore appears to be feasible aerodynamically. Additional wind tunnel tests are required on the free wing with flap and slat extended. Author (TAB)

N70-22610*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESPONSE OF SEVERAL TURBOJET AIRPLANES TO RUNWAY ROUGHNESS
Garland J. Morris Washington Mar. 1970 65 p refs
(NASA-TN-D-5740; L-6261) Avail: CFSTI CSCL 01C

Studies were made of the responses of a heavy bomber, medium bomber, tanker, trainer, civil transport, and business jet to runway roughness. Airplane responses were measured on both satisfactory runways and on runways which had been the subject of roughness complaints from operational personnel. Measurements included pitching velocity, landing-gear-strut motions, and normal acceleration at the cockpit, center of gravity, and tail. Author

N70-22614*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUMMARY OF A FLIGHT-TEST EVALUATION OF THE CL-84 TILT-WING V/STOL AIRCRAFT
Henry L. Kelley, John P. Reeder, and Robert A. Champine Washington Mar. 1970 84 p refs
(NASA-TM-X-1914; L-6570) Avail: CFSTI CSCL 01C

An abbreviated flight-test evaluation of a second-generation aircraft was conducted to ascertain possible problem areas. In general, based on the limited evaluation possible, most of the flying qualities in the hover, transition, and cruise modes of flight were considered good. However, an indicated rate-of-descent limit of 700 ft/min, defined by loss of control due to stalling, at a typical STOL airspeed of 42 knots did not appear to provide enough margin for ultimate operational use. Furthermore, low normal-velocity damping was encountered at about 40 knots airspeed at indicated rates of descent desirable for operational use. This characteristic appeared as a prolonged increase in rate of descent following a small power reduction, and is thought to be significant for instrument flight. According to pilot observations and the time histories, this characteristic occurred with power settings for initial indicated rates of descent as low as 300 ft/min. Buffeting was not always apparent to the pilot as excessive sink rates developed and, in several descents at altitude, the first indications of approach to limiting stalling were pitch-down and roll-off that occurred at an indicated rate of descent of about 700 ft/min. This behavior may be related to aerodynamic characteristics at angles of attack near maximum lift. Author

N70-22815*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FULL-SCALE WIND-TUNNEL INVESTIGATION OF THE STATIC LONGITUDINAL AND LATERAL CHARACTERISTICS OF A LIGHT SINGLE-ENGINE AIRPLANE
Marvin P. Fink, Delma C. Freeman, Jr., and H. Douglas Greer Washington Mar. 1970 139 p refs
(NASA-TN-D-5700; L-7012) Avail: CFSTI CSCL 01C

Tests were made over an angle-of-attack range of −4 deg to 20 deg and over a sideslip range of + or − 8 deg at thrust coefficients of 0, 0.20, and 0.46. Control effectiveness was taken for a full range of deflections on the aileron, elevator, rudder, and flap. Downwash measurements at tail were also obtained for the range of thrust coefficient and flap deflection. The following conclusions were drawn: The airplane has stick-fixed longitudinal stability through the stall for all configurations of the test, the center of gravity being located at 0.10 mean aerodynamic chord. Power generally has a small destabilizing effect, but the airplane is statically stable even with the aft center-of-gravity location. The airplane is directionally stable and has positive effective dihedral through the stall for all conditions of the test. Aileron and rudder effectiveness is maintained through the stall. Aileron and rudder controls are powerful enough to trim out all asymmetric airplane moments through the stall. Author

N70-22873*# Battelle Memorial Inst., Columbus, Ohio.
A PROCEDURE FOR ASSESSING AIRCRAFT TURBULENCE-PENETRATION PERFORMANCE
Richard F. Porter, James P. Loomis, and Alfred C. Robinson Washington NASA Mar. 1970 156 p refs
(Contract NASw-1737)
(NASA-CR-1510) Avail: CFSTI CSCL 01C

A concept of a numerical rating for turbulence penetration performance is suggested which goes beyond exclusive consideration of structural loads. This performance rating is taken as the combined probability, at any instant of time, that the state vector defining the aircraft's perturbation behavior will lie in an undesirable region as defined by a constraint envelope representing the multiple hazards surrounding the trim point. An investigation and evaluation of an elementary form of the general concept is made, with the constraints being limited to those which may be drawn in a two-dimensional space defined by angle-of-attack and airspeed excursions. The constraints are buffet, positive and negative load factor, minimum control speed, maximum dynamic pressure, and maximum Mach number. The effort is confined to the class of large subsonic jet transports in cruise configuration; and, while limited to longitudinal rigid body motion, includes all three basic aircraft degrees of freedom as well as closed loop elevator and throttle control. Conventional power spectral density techniques are employed to consider the combined effects of uncorrelated vertical and head-on isotropic turbulence. Author

N70-22880*# National Aeronautics and Space Administration, Washington, D.C.
BASIC AERODYNAMIC NOISE RESEARCH Conference
Ira R. Schwartz, ed. 1969 540 p refs Conf. held in Washington, D.C., 14–15 Jul. 1969; sponsored by NASA
(NASA-SP-207) Avail: SOD $2.25; CFSTI CSCL 20A

Thirty one papers on basic noise research related to aircraft propulsion systems are presented. Main topics discussed are: theoretical and experimental aspects of jet exhaust; rotating fan, inlet duct, and boundary layer noise research; experimental diagnostic techniques; and proposals for noise reduction and control. Also documented are conference panel discussions. E.M.C.

N70-22933# Politecnico di Torino (Italy). Ist. di Progetto di Aeromobili.
A SECOND ANALYSIS OF THE GABRIELLI VON KARMAN CRITERION OF SOME MODERN TYPES OF TRANSPORT AIRCRAFT AND THEIR DEVELOPMENTS [ANALISI SECONDO IL CRITERIO GABRIELLI VON KARMAN DI ALCUNI MODERNI TIPI DI VEICOLI DA TRASPORTO E LORO LINEE DI SVILUPPO]
L. Guerra [1969] 33 p refs In ITALIAN /its Publ. No. 53
Avail: CFSTI

The developments in vehicular transportation are reviewed. Included are brief descriptions of ships, air cushion vehicles, helicopters, and transport aircraft including turbojets and turboprops. The Gabrielli-Karmen graph showing the velocity versus power for various vehicles is included. The stability systems, and design dimensions for each type of vehicle are discussed. Transl. by F.O.S.

N70-22957# Royal Aircraft Establishment, Farnborough (England).
PROPOSAL FOR A VEHICLE FOR THE MEASUREMENT OF TYRE/RUNWAY FRICTION
B. Smilling Sep. 1967 26 p refs
(RAE-TR-67244-Rev) Copyright. Avail: CFSTI

The need for a test vehicle for high speed wet friction measurement between aircraft tires and runway surfacing is pointed out. It is shown that by using a driven tire, the important actions taking place in the tire footprint during braking can be reproduced at much lower speeds. Proposals are made for a test vehicle which would enable tires for heavy supersonic aircraft to be tested fully and could also be driven on the public roads for transport between airfields. Author (ESRO)

N70-23038# France. Service Technique de l'Aeronautique, Paris.
MIRAGE 3 AUTO-ADAPTABLE SYSTEMS [ESSAIS DE SYSTEMES AUTO-ADAPTABLES SUR MIRAGE 3]
J. C. Peard *In* AGARD Advanced Control System Concepts Jan. 1970 p 169–181 In FRENCH (See N70-23026 10-21)
Avail: CFSTI

The performance of self adaptive control systems on Mirage 3 is discussed. Results of tests performed with the active 140-type and passive 166-type dampers are outlined. It is shown that the 140-type damper requires a longer range of improvement in the chain of adaptive gain, while the 166-type was effective only with limited capacities of self adaptation. Recommendations for damper improvements are included. Transl. by J.M.C.

N70-23041# France. Service Technique de l'Aeronautique, Paris.
THE INFLUENCE OF SYSTEM RELIABILITY ON ACCIDENT HAZARDS DUE TO POOR HANDLING QUALITIES
Jean-Claude L. Wanner *In* AGARD Advanced Control System Concepts Jan. 1970 p 193–202 (See N70-23026 10-21)
Avail: CFSTI

Flight accidents resulting from poor handling qualities are analyzed, as well as the probability of an accident occuring during different phases of flight time. Accidents were classified as: (1) crew failure due to difficulty in piloting aircraft; (2) crew failure to compensate for unexpected obstacles; and (3) uncontrollable disturbances, equipment failure, and atmospheric effects. J.A.M.

N70-23042# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
VTOL IFR TECHNOLOGY PROGRAM
John H. Kearns, III and Robert A. Bondurant, III *In* AGARD Advanced Control System Concepts Jan. 1970 p 203–210 (See N70-23026 10-21)
Avail: CFSTI

The program concerned with achieving an IFR operational capability for VTOL weapon systems in a manner which maximizes flight safety considerations for the operational pilot is discussed. The force steering concept is presented for pilot activity in control loop. Author

N70-23043# Smiths Industries, Ltd., Cheltenham (England). Aviation Div.
CONTROL FUNCTION SELECTION MONITORING

E. W. Anderson *In* AGARD Advanced Control System Concepts Jan. 1970 p 211–218 (See N70-23026 10-21)
Avail: CFSTI

Multipurpose displays using cathode ray tubes and future systems using electroluminescence are presented. Pairing of electronic displays is suggested to prevent a mission abort or endangering the aircraft; this duplex system provided a method for self-checking of displays. Typical displays, control problems, single seater aircraft, and computing control are also discussed. J.A.M.

N70-23063# British Aircraft Corp., Weybridge (England). Aircraft Labs.
THE ENVIRONMENT ENCOUNTERED IN AIRCRAFT SERVICE
W. Astley and J. Scott *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 9 p (See N70-23051 10-17)
Avail: CFSTI

Factors which make up the aircraft environment are considered dealing first with atmospheric influences, followed by the basic aircraft materials and systems, and finally those conditions imposed by the operational role of the aircraft. The importance of interaction between the individual factors in considering the total aircraft environment is stressed. There is a brief description of work to relate the analysis of aircraft contaminant fluids with corrosion behavior, together with preliminary results. Finally it is suggested that modern corrosion protection methods make it possible to eliminate the collective effects of the environment, provided there is an adequate understanding of the problem in design, production, and maintenance. Author

N70-23105*# National Aeronautics and Space Administration. Langley Research Station, Langley Station, Va.
WIND-TUNNEL INVESTIGATION OF A V/STOL TRANSPORT MODEL WITH SIX WING-MOUNTED LIFT FANS
William A. Newsom, Jr. and Frederick L. Moore Washington Mar. 1970 120 p refs
(NASA-TN-D-5695; L-6816) Avail: CFSTI CSCL 03C

The wind tunnel investigation included force and moment measurements over a range of angles of attack and sideslip through the transition speed range for several power conditions. The static longitudinal, lateral, and directional stability characteristics were determined for several configurations, and lift fan thrust performance was measured. The model had an increase in lift with increasing airspeed and, in general, showed static longitudinal, lateral, and directional stability for most of the test conditions. Slipstream flow at the tail for the powered-lift condition was similar to that of conventional airplanes in terms of dynamic pressure and downwash factor, but there was a decidedly adverse sidewash effect. The adverse sidewash was compensated to a considerable extent, however, by the basic stability of the model, which was about neutrally stable, rather than unstable, with the vertical tail off. Author

N70-23107# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SONIC-BOOM CHARACTERISTICS IN THE EXTREME NEAR FIELD OF A COMPLEX AIRPLANE MODEL AT MACH NUMBERS OF 1.5, 1.8, AND 2.5
Odell A. Morris, Milton Lamb, and Harry W. Carlson Washington Apr. 1970 27 p refs
(NASA-TN-D-5755; L-6407) Avail: CFSTI CSCL 20A

A wind tunnel investigation of the near field sonic boom characteristics of a model of a large supersonic bomber configuration were conducted. Experimental pressure signatures were obtained at distances that were two and four times the model length for various angles of attack and various control-surface settings. Representative measured signatures are compared with theoretical estimates. Author

N70-23161*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THREE-TRACK RUNWAY AND TAXIWAY PROFILES MEASURED AT INTERNATIONAL AIRPORTS C AND D
Albert W. Hall Washington Mar. 1970 101 p refs
(NASA-TN-D-5703; L-7069) Avail: CFSTI CSCL 03C

Three-track runway and taxiway profiles are presented for use in studies of airplane response to ground roughness. The tabulated and plotted data for two international airports (designated airports C and D) are presented. Author

N70-23222# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
COMPARISON OF THE TAKE-OFF AND LANDING PERFORMANCES OF JET- AND FAN- VTOL-AIRCRAFT [VERGLEICH VON START- UND LANDELEISTUNGEN STRAHLGESTUETZTER SENKRECHTSTARTER]
Hellmut Herb Oct. 1969 42 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-61) Avail: CFSTI

The demand for fast aircraft which could take-off and land vertically led to a variety of types of aircraft. Whereas the advantages and disadvantages of the individual modals are discussed, particularly the arrangement of the engines; no comparison was made so far of the values really attained by means of computations of wind tunnel measurements and flight tests., the investigations dealing with the performance of the different modules during take-off, landing, and the transition flights are presented. Author (ESRO)

N70-23226*# Techtran Corp., Glen Burnie, Md.
SYSTEMS FOR DEFLECTION OF THE JET STREAMS OF TURBO-JET ENGINES
A. A. Svyatogorov et al Washington NASA Mar. 1970 208 p refs Transl. into ENGLISH of the book "Ustroystva Dlya Otklonenlya Reaktivnoy Strui Turboreaktivnykh Dvigateley" Moscow, Mashinostroyeniya, 1968 p 1–237
(Contract NASw-1695)
(NASA-TT-F-603) Avail: CFSTI CSCL 03C

Turbojet engine thrust reversers and devices for deflecting the jet exhaust are examined. The present status of research and development of reversers and deflecting devices is described, and domestic priorities in building reversers is emphasized. The efficiency of thrust reversal in braking aircraft upon landing and in flight is indicated, as well as efficiency in deflecting the jet exhaust downward to shorten the takeoff and landing distance. A classification is given and principles laid down for building reverser and deflecting devices and examples of the construction of a variety of devices are cited. The fundamentals of gas-dynamic calculation of reverser and deflection devices are given. The method of calculation is illustrated by an example of the development of a reverser design from data of experimental research. Author

N70-23255# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
FLIGHT TESTING OF ROTOR BLADES OF GLASS FIBRE REINFORCED PLASTICS FOR ALOUETTE 2 DESIGNED BY BOELKOW [FLUGERPROBUNG VON GFK-ROTORBLAETTERN FUER ALOUETTE 2 NACH BAUWEISE BOELKOU]
Roman Jamka, Horst Homa, and Werner Raspe Aug. 1969 88 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-72) Avail: CFSTI

Flight tests are reported with Bolkow rotor blades of glass-fiber reinforced plastics. The program and measuring techniques for the flight tests, which were carried out with an Alouette 2 helicopter, are described, and the possible errors are discussed. The blade stresses measured at different flight attitudes as a function of radius

and azimuth angle psi are compared with theory. All the measured stresses remained within the limits given by the manufacturers.
Author (ESRO)

N70-23282*# Wyle Labs., Inc., Huntsville, Ala. Testing Div.
SOME APPLICATIONS OF JET NOISE THEORY
M. V. Lowson and S. P. Pao Feb. 1970 45 p refs
(Contract NAS8-21060)
(NASA-CR-102579; WR-70-4) Avail: CFSTI CSCL 20A

Results from existing theories for jet noise are critically reviewed for their practical inferences, and they are applied to some practical problems. Shear noise is found to produce half the sound power but double the peak sound pressure of self noise. By means of the Pao–Lawson theory and a set of new aerodynamic data for a low speed jet exhaust flow, the absolute magnitude of self noise source intensity distribution in a jet is calculated. The axial variation of source strength shows almost constant effectiveness over the initial mixing region with a shallow peak near the end of the potential core. Significant noise radiation occurs down to ten diameters from the exit, with similarity conditions applying only beyond about fifteen diameters. Nearly sixty percent of the noise is found to be radiated from the region of the jet downstream of the potential core. An empirical relation between shear and turbulent intensity suggests that the results are equally applicable to shear and self noise, at least in the initial region. Integration of local source strength over the whole jet gives a theoretical value of the Lighthill parameter for jet noise as 0.000033 in comparison with the empirical value of 0.00003 for low speed jets. The spectrum of the overall noise for a low speed jet has also been evaluated. The peak noise is found near a Strouhal number of 0.30. The predicted spectral shape is in close agreement with experiment.
Author

N70-23353# Fraunhofer Institut, Freiburg (West Germany).
INTENSITY VARIATIONS OF HYPERSONIC BOOMS DUE TO ATMOSPHERIC INHOMOGENEITIES [INTENSITAETSAENDERUNG DES UEBERSCHALLKNALLS INFOLGE ATMOSPHAERISCHER INHOMOGENITAETEN]
W. Merzkirch 1969 17 p refs In GERMAN
(Rept-3-69) Avail: CFSTI

The shock wave of a hypersonic aircraft is refracted by atmospheric inhomogeneities. In this report only those inhomogeneities which are due to seasonal or weather influences and occur in the immediate neighborhood of the earth's surface were considered. Only the sonic boom at large distances from the aircraft and in an isoberic atmosphere was considered for deriving an analytic and explicit solution for the pressure variations. ESRO

N70-23406# National Physical Lab., Teddington (England). Hovercraft Unit.
HEAVE SUSPENSION CHARACTERISTICS AND POWER REQUIREMENTS OF A PLENUM AIR CUSHION
J. H. W. Wheatley Dec. 1969 38 p refs
(NPL-Hovercraft-9) Copyright. Avail: CFSTI

A preliminary analysis is presented of the heave suspension characteristics of a plenum chamber air cushion system, and a tentative cushion power criterion as a function of craft response is derived.
Author (ESRO)

N70-23433# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer dynamik der Flugsysteme.
FLIGHT PERFORMANCE MEASUREMENTS IN UNSTEADY AND STEADY FLIGHT CONDITIONS WITH A FOUGA CM 170 'MAGISTER' [ERGEBNISSE VON FLUGLEISTUNGSMESSUNGEN BEI INSTATIONAEREN UND STATIONAEREN FLUGZUSTAENDEN MIT DEM FLUGZEUG FOUGA CM 170 'MAGISTER']
Alois Leibold Oct. 1969 76 p refs In GERMAN; ENGLISH summary
(Contract T-01-410-I-205)
(DLR-FB-69-75) Avail: CFSTI

The objective was to test and to compare the results obtained by a modern technique of measuring flight performances. The modern technique consisted of measuring the total energy with respect to time during accelerated horizontal flights and constant Mach-number climbs. The conventional technique consisted of measuring the potential energy with respect to time during stabilized climbs. The measurements for all tests were obtained from a Fouga CM 170 Magister. Approximately 1000 measurements were taken during nonstabilized flight conditions and about 50 during stabilized flight conditions.
Author (ESRO)

N70-23444# Army Natick Labs., Mass.
WIND EFFECT ON GLIDING PARACHUTE SYSTEMS WITH NON-PROPORTIONAL AUTOMATIC HOMING CONTROL
Thomas F. Goodrick Nov. 1969 68 p
(AD-698458; USA-NLABS-TR-70-28-AD) Avail: CFSTI CSCL 1/3

Equations are presented and evaluated for estimating the wind effect on the approach path and descending orbit of gliding parachute systems with non-proportional automatic homing control. Exact equations are presented for determining certain characteristic features of the descending orbit. Iteration equations are presented incorporating homing simulation for calculating points at equal time intervals along the ground track. The control response time, effect of deployment position, and impact position probability are discussed. An empirical equation for the radius of the circle of equal probability as a function of turning radius, wind velocity, and system velocity is presented. A parametric analysis of the equations is given for systems with glide ratios from 2.0 to 3.0 and turning radii of 75 ft and 100 ft in winds of from 4 to 32 fps. The analysis shows that accuracy is more dependant on high glide ratio than on turning radius.
Author (TAB)

N70-23491# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
FLIGHT MEASUREMENTS OF GROUND EFFECT ON THE LIFT AND PITCHING MOMENT OF A LARGE TRANSPORT AIRCRAFT (COMET 3B) AND COMPARISON WITH WIND TUNNEL AND OTHER DATA
C. O. O'Leary Aeron. Res. Council 1969 16 p refs Supersedes RAE-TR-68158; ARC-30616
(ARC-R/M-3611; RAE-TR-68158; ARC-30616) Copyright. Avail: CFSTI

Ground effect on lift and pitching moment was measured on a Comet 3B in flight. The flight results are in reasonably good agreement with wind tunnel results and semiempirical prediction data.
Author (ESRO)

N70-23518# Teledyne Systems Co., El Segundo, Calif.
INTEGRATED AVIONIC SYSTEM DESIGN FOR HELICOPTERS AND VTOL
Lawrence A. Kaufman *In* AGARD Hybrid Navigation Systems Jan. 1970 30 p (See N70-23501 10-21)
Avail: CFSTI

This paper reviews the system concepts employed in the development of the Integrated Helicopter/VTOL Avionics System (IHAS). The concept review starts with a definition of the overall system organization scheme, identifying the system sensors, data processors and output elements. The digital interface design technique is next described. Then the major concepts for each of the individual subsystems of the IHAS is discussed including flight control, navigation, terrain following, stationkeeping and displays. This concludes the review of the on-line system and is followed with a presentation of the off-line self-test concepts both pre-flight and in-flight and of the diagnostic properties of the central computer used to evaluate the specific mode consequence of any equipment failure. The review of system concepts is completed with a description of the computer central complex, covering the hardware

architecture used. The next section of the paper presents a critique of the IHAS design concepts, based on experiences in the development and test of the system. This critique includes discussions of critical design problems resulting from some of the concepts previously described and of the solutions to these problems. The critique continues with commentary on the effectiveness consequences of some of the concepts employed in the system design leading to recommendations for future concepts. The paper is concluded with some examples of future functional capabilities which can be realized for helicopters and VTOL aircraft using the integrated system technology base afforded by IHAS. Author

N70-23523*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FULL-SCALE WIND-TUNNEL INVESTIGATION OF A TARGET-TYPE THRUST REVERSER ON THE A-37B AIRPLANE

Michael D. Falarski and Kenneth W. Mort (Army Aeron. Res. Lab.) Washington Apr. 1970 18 p refs

(NASA-TM-X-1985; A-3419) Avail: CFSTI CSCL 01A

Full-scale wind-tunnel tests were conducted to determine the aerodynamic characteristics of the A-37B airplane equipped with target-type thrust reversers. Operation of the reversers caused large decrease in longitudinal stability and control and severe airplane buffetting. Exposure to the exhaust gas plumes caused failure of the flap and reverser control mechanisms and caused skin distortion. Reverser operation in ground effect was limited by exhaust gas ingestion into the engine inlets. Author

N70-23547*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A STATISTICAL STUDY OF NORMAL LOAD FACTOR JUST PRIOR TO GROUND CONTACT FOR FIVE LIGHT AIRPLANES

Albert W. Hall Washington Apr. 1970 21 p refs

(NASA-TN-D-5767; L-6908) Avail: CFSTI CSCL 03C

The normal load factor just prior to ground contact has been determined from VGH records of 980 landings of five light airplanes. Frequency-distribution and probability curves have been fitted to the data samples for each airplane. The distributions of normal load factor just prior to ground contact had mean values ranging from 0.962 to 1.013 with standard deviations ranging from 0.039 to 0.074. Author

N70-23549# National Gas Turbine Establishment, Farnborough (England).

THE DEVELOPMENT OF A DUMMY BIRD FOR USE IN BIRD STRIKE RESEARCH

A. W. R. Allcock and D. M. Collin Aeron. Res. Council 1969 70 p refs Supersedes NGTE-R-303; ARC-30697

(ARC-CP-1071; NGTE-R-303; ARC-30697) Copyright. Avail: CFSTI

The problems of using bird carcases in bird strike testing are mentioned and the development of a dummy bird is described. Dummies of wax, wood, flexalkyd foam, emulsion, and gelatine were tested, first by impacts on very simple basic target shapes, and then on engine inlet guide vane assemblies. Comparison of the results with those from chicken carcases showed that the foam, emulsion, and gelatine dummies were all realistic simulators. The gelatine dummy is recommended because of its successful history of use as a flesh simulator in other types of impact study and because of its cheapness and ease of manufacture. The deflections measured using the special targets agreed quite well with simple theoretical calculations. Approximate values of the friction coefficient of the carcases and dummies were derived from high-speed films and the deflection measurements. The tests on the inlet guide vanes showed that blade damage was approximately proportional to projectile momentum, and that rotation of the (variable) blades even 5 deg out of the projectile line of flight greatly reduced their damage resistance. Author (ESRO)

N70-23552# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

A MODEL FOR THE AQUAPLANING OF TYPES ON WET RUNWAYS

J. C. Cooke 1969 28 p refs

(ARC-CP-1078; RAE-TR-67228; ARC-29884) Copyright. Avail: CFSTI

An attempt is made to estimate pressure distribution, tire deflection, and lift on a fully aquaplaning smooth tire. The problem is reduced to solving two coupled partial differential equations, namely Rayleigh's lubrication equation for the water and the membrane equation for the tire. It appears that viscosity is not important except for the no-slip condition it implies. The conclusion is reached that it will be essential to solve a three-dimensional free stream surface problem in order to make further progress. Author (ESRO)

N70-23579# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

V/STOL, VALID FOR THE FUTURE CIVIL AND/OR MILITARY USE? [V/STOL, RICHTUNGWEISEND FUER DEN ZUKUENFTIGEN ZIVILEN UND/ODER MILITAERISCHEN EINSATZ?]

R. Riccius 1969 29 p refs In GERMAN; ENGLISH summary Presented at the DGLR Ann. Meeting, Bremen, 22–24 Sep. 1969 Avail: CFSTI

An inventory of hitherto developed and flying V/STOL aircraft is made and those problems are indicated which have not yet been satisfactorily solved in the course of V/STOL development. This is compared with the increasing demand for civil and military V/STOL application and the expected trend of further development is deduced. In the light of the results the focal points on which the efforts of government, science, research, and industry should be concentrated to solve future defense tasks, as well as transportation and intercity traffic problems, by introducing V/STOL aircraft are discussed. Author (ESRO)

N70-23580# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Aerodynamische Versuchsanstalt.

ON THE PROBLEM OF ORTHOGONALITY OF NATURAL VIBRATION MODES OF AIRCRAFT [ZUR FRAGE DER ORTHOGONALITAET DER EIGENSCHWINGUNGSFORMEN VON FLUEKOERPERN]

H. Foersching and K. Stolze Jul. 1969 34 p refs In GERMAN; ENGLISH summary Presented at the DGLR Ann. Meeting, Bremen, 22–24 Sep. 1969

(AVA-FB-6912) Avail: CFSTI

Analytical investigations of the orthogonality of the natural modes of aircraft have been performed using results of ground vibration measurements carried out on the F-104 G aircraft. With the theoretical mass distribution and the measured natural mode amplitudes the complete matrix of the generalized masses was calculated. Guided by these results detailed considerations with respect to the orthogonality of the measured natural modes and the accuracy of the measured generalized masses are presented. Author (ESRO)

N70-23789# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

THE LANDING FLARE OF LARGE TRANSPORT AIRCRAFT

W. J. G. Pinsker London HMSO 1969 53 p refs Supersedes RAE-TR-67297; ARC-30353

(ARC-R/M-3602; RAE-TR-67297; ARC-30353) Avail: CFSTI

The factors are considered which influence the landing flare, especially of large aircraft. The height required for the flare is a function of the performance and the dynamic response characteristics of an aircraft but, in practice, limitations of pilots' judgement may make it more difficult, to realize fully the theoretically available flare capability and the desired precision in touchdown

control. These limitations may increase the required weather minima and also the margins in runway-length to accommodate the increased scatter of touchdown, unless aids are provided to assist the pilot. Recovery from disturbances due to gusts during the landing flare is also shown to become marginal for the large aircraft with more sluggish elevator response. Maneuver boost offers scope for significant improvement, but for the very large aircraft direct lift control appears the most promising technique capable of overcoming this and other problems. Author (ESRO)

N70-23804# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
POSSIBILITIES OF ECONOMIC USE OF JET PASSENGER PLANES FOR REGIONAL AIR TRAFFIC [MOEGLICHKEITEN DES WIRTSCHAFTLICHEN EINSATZES VON STRAHLVERKEHRSFLUGZEUGEN IM REGIONALLUFTVERKEHR]
R. Stuessel 1969 46 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22–24 Sep. 1969
Avail: CFSTI

The problem of whether modern jet aircraft can be used economically for short distances and especially for local airlines in Germany, is discussed. The requirements necessary for short-distance jet passenger planes are defined. As a possibility, the VFW 614 twin-engine jet airplane, which is being developed at the Vereinigte Flugtechnische Werke, Bremen, is compared with existing twin-engine jet planes. ESRO

N70-23815# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
THE INFLUENCE OF COUPLED NON-STATIONARY GUSTS ON LONGITUDINAL AIRCRAFT MOTION [EINFLUSS VON VERKOPPELTEN INSTATIONAREN BOENSTOERUNGEN AUF DIE FLUGZEUGLAENGSBEWEGUNG]
Gunther Schaenzer (Ph.D. Thesis—Brunswick Univ.) Jun. 1969 188 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-65) Avail: CFSTI

The influence of vertical and horizontal gusts on the longitudinal motion of an aircraft at low airspeeds is represented by a system of eight multi-variable transfer functions. Non-stationary gust effects are presented explicitly. At high and low frequencies limit considerations furnish convenient explicit relations which are supplemented by numerical calculations (root loci, Bode-plots, step responses) for the medium frequency range. The effect of non-stationary and coupled gusts on two well-known single loop flight control systems is discussed (automatic throttle control and gust alleviation systems). In the frequency range of maximum gust strength the effects of horizontal and vertical gusts are of the same order of magnitude while vertical gusts predominate at high and low frequencies. Non-stationary gusts and wind shear, as well as thrust moments and small aspect ratios, produce appreciable non-minimum-phase-loss effects in all eight transfer functions, occasionally resulting in considerable quasi-dead time phenomena. Author (ESRO)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N70-22505# European Space Research Organization, Paris (France).
PROCEEDINGS OF THE SIXTH ESRO SUMMER SCHOOL VOLUME 9: SPACE POWER SYSTEMS: SOLAR CELL ARRAYS
Aug. 1969 56 p refs Conf. held at Noordwijk, Neth., 1968
(ESRO-SP-48) Avail: CFSTI

CONTENTS:

1. INTEGRATION OF SOLAR CELLS INTO MODULES G. Seibert (ESRTC) p 1–15 refs (See N70-22506 10-03)
2. DESIGN OF SOLAR CELL ARRAYS AND THEIR PERFORMANCE IN SPACE K. K. Reinhartz (ESRTC) p 17–33 refs (See N70-22507 10-03)
3. ADVANCED SOLAR CELL ARRAY CONCEPTS K. K. Reinhartz (ESRTC) p 35–52 refs (See N70-22508 10-03)

N70-22506# European Space Research and Technology Center, Noordwijk (Netherlands).
INTEGRATION OF SOLAR CELLS INTO MODULES
G. Seibert *In* ESRO Proc. of the 6th ESRO Summer School, Vol. 9 Aug. 1969 p 1–15 refs (See N70-22505 10-03)
Avail: CFSTI

Problems associated with the layout and construction of silicon solar cell modules are discussed. The advantages and disadvantages of different kinds of module mounting are presented. The physical properties of interconnector and contact materials commonly used are reviewed, and a weight breakdown is given of a module representing the state of the art in Europe. The transmittance degradation of cover slips and adhesives in an electron, proton, and ultraviolet environment is assessed, and optical matching problems of the complete system of solar cell and cover slide are discussed. Author (ESRO)

N70-22507# European Space Research and Technology Center, Noordwijk (Netherlands).
DESIGN OF SOLAR CELL ARRAYS AND THEIR PERFORMANCE IN SPACE
Klaus K. Reinhartz *In* ESRO Proc. of the 6th ESRO Summer School, Vol. 9 Aug. 1969 p 17–33 refs (See N70-22505 10-03)
Avail: CFSTI

The parameters are described which are important for solar generator design for spacecraft. Orbit parameter effects and the constraint effects imposed by the spacecraft are studied. Characteristics of fixed and oriented solar cell arrays and their mechanical design are also reviewed. The methods of electrical interconnection in an array are discussed, with emphasis on shadow effects and reliability considerations. Solar cell array performance in space is described, and typical values of the mass of solar generators are given. Author (ESRO)

N70-22508# European Space Research and Technology Center, Noordwijk (Netherlands).
ADVANCED SOLAR CELL ARRAY CONCEPTS
Klaus K. Reinhartz *In* ESRO Proc. of the 6th ESRO Summer School, Vol. 9 Aug. 1969 p 35–52 refs (See N70-22505 10-03)
Avail: CFSTI

Based on the performance of present solar cell arrays, a determination is made of the areas of potential improvements. It is shown that, if the power-to-weight ratio is to be increased to 40 W/kg, not only must the solar cell performance be improved but also new designs for the panel structure in the array must be realized. The basic problems in the design of lightweight arrays are discussed. Some advanced development projects for arrays with silicon and with thin-film solar cells are described. Author (ESRO)

N70-22537# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
PRIMARY ENERGY STORAGE AND THE SUPER FLYWHEEL
D. W. Rabenhorst Sep. 1969 65 p refs
(Contract NOw-62-0604-C)

(AD-697906; APL-TG-1081) Avail: CFSTI CSCL 10/3

This report describes new flywheel configurations that promise an order of magnitude improvement as energy storage devices. As presently conceived, the energy density has been improved over ten times, with the prospect for additional improvement in performance as the next generation of high strength uniaxial filamentary materials becomes available. This super flywheel is significant in its application to the urban electric vehicle. Instead of only being used to reduce the acceleration power requirements, as has been proposed in many studies, the new flywheel can actually be used as the primary energy source, and batteries can be eliminated altogether. Many other applications are also discussed. Author (TAB)

N70-22825*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SECONDARY AEROSPACE BATTERIES AND BATTERY MATERIALS A Bibliography

G. Halpert and W. H. Webster, Jr. Washington Aug. 1969 15[illegible] p refs

(NASA-SP-7027) Avail: CFSTI CSCL 10C

This annotated bibliography on the subject of secondary aerospace battery materials and related physical and electrochemical processes was compiled from references to journal articles published between 1923 and 1968. Citations are arranged in chronological order under journal titles. Indices by system, component processes, and author are included. Author

N70-22909*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

POWER SYSTEM DESIGN

In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 41 p (See N70-22901 10-31)

Avail: CFSTI CSCL 10B

Alternate solar array configurations are considered for the electrical power requirements of the spacecraft. A solar cell module was specially designed for the baseline spacecraft. A foldout array was studied for the possibility that power requirements might increase. The charger battery regulator module used in the study was not designed for the required configuration and power system lifetime of the HEAO, but the loss in overall efficiency and peak power from matching the solar cell outputs from the different sides of the satellite to the charger battery regulator module is not critical. Recommendations are given for selecting the best quality and design of rechargeable batteries. R.B.

N70-22921*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

POWER SYSTEM DESIGN, APPENDIX H

In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 32 p refs (See N70-22901 10-31)

Avail: CFSTI CSCL 10B

Design and sizing of the power system and its components were based on the maximum power capability of the surface area available for the solar array, based on the fact that power requirements are likely to increase. Maximum power available is limited to 820 watts, which includes 260 watts available for contingency. The problems emphasized in the design include the preliminary solar array layout, preliminary power system design, operational analysis, batteries, and load sharing. The power system design is based on use of Apollo telescope mount equipment where possible. R.B.

N70-22942# Sandia Corp., Albuquerque, N.Mex.

HEAT-SENSING THERMAL BATTERY

S. C. Levy Oct. 1969 31 p refs

(PB-187704; SC-RR-69-697) Avail: CFSTI CSCL 10C

The report describes research conducted to prove the feasibility of using a low-temperature autoactivated thermal battery for fire detection and protection applications. A two-cell battery was developed which is self-activating at temperatures near 200 deg C and is capable of supplying a pulse of electrical power greater than 40 watts (20 amperes at 2 volts). Autoactivation of the battery is accomplished with a new heat generator, developed specifically for this application. Heat is generated by the exothermic alloying of lithium with a lead-tin mixture, releasing up to 230 cal/g in a rapid reaction at approximately 186 deg C. Author (USGRDR)

N70-23162*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CATHOLYTE STUDIES IN COPPER OXIDE-MAGNESIUM THERMAL CELLS

Lawrence H. Thaller Washington Apr. 1970 15 p refs

(NASA-TN-D-5731; E-5482) Avail: CFSTI CSCL 10C

Evaluation of the Mg/LiCl-KCl/Cu2O thermal cell at 450 C is presented. This phase of the program is concerned with mass transport within the cells and how it affects the open-circuit voltage of single cells. During the latter stages of discharge (beyond about 50-percent depth of discharge), a large drop in the open-circuit voltage (approximately 0.25 V) occurs. This has been found to be caused by the formation of a complex which reduces the activity of the cuprous ion by about two orders of magnitude. Potentiometric titrations of cuprous ion with lithium oxide were performed in an attempt to more accurately characterize this interaction. The changing mass transport conditions present inside a discharging thermal cell cause this cuprous complex to be formed only during the latter stages of discharge. Author

N70-23163*# General Electric Co., Philadelphia, Pa.

DESIGN, DEVELOPMENT, AND DEMONSTRATION OF A WARM GAS DISTRIBUTION REGULATOR Final Report, Period Ending 10 Aug. 1969

10 Sep. 1969 112 p refs Prepared for JPL

(Contract NAS7-100; JPL-951988)

(NASA-CR-109354; DOC-69SD4354) Avail: CFSTI CSCL 13K

The successful design, development and demonstration of a pneumatic regulator for a warm gas distribution system is reported. Component design, development and life test results are discussed. Performance obtained in testing of an advanced soft seat design over a range of temperatures and in a one-million cycle life test is believed to represent best performance obtained to date within current state of the art. Author

N70-23194*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE NIMBUS ENERGY BALANCE COMPUTER PROGRAM

A. F. Obenschain and R. Rasmussen Feb. 1970 98 p refs

(NASA-TM-X-63859; X-716-70-43) Avail: CFSTI CSCL 10B

The Nimbus Energy Balance Computer Program combines the known electrical characteristics of the power supply components and simulates the operation of three general types of power systems – Nimbus, Series Maximum Power Point Tracker and Parallel Maximum Power Point Tracker – as the spacecraft passes through a complete orbital cycle. The effect of load changes, battery failure or changes in operating characteristics, solar array degradation or partial failure, and changes in electrical component characteristics on power system energy balance can be easily obtained; energy balance is defined as the condition where sufficient power exists to supply the spacecraft loads and completely recharge the batteries during a given orbit. The output of the program is a summary of the operating condition of the various system components at user-specified time increments during an orbit. Author

N70-23218# Royal Aircraft Establishment, Famborough (England).

TYPE APPROVAL TEST REPORT ON FERRANTI SOLAR CELLS FOR THE BLACK ARROW X3 SPACECRAFT

A. A. Dollery Mar. 1969 22 p

(RAE-TR-69046) Copyright. Avail: CFSTI

Type approval tests have been carried out on Ferranti 2 cm × 2 cm, 10 ohm cm n-on-p solar cells with nickel-copper-gold plated contacts, to determine their suitability for use as the electrical power source on the Black Arrow X3 spacecraft. Results were satisfactory and full type approval is recommended. Author (ESRO)

N70-23257# European Space Research and Technology Center, Noordwijk (Netherlands).

INCREASED SOLAR CELL OUTPUT BY IMPROVED OPTICAL MATCHING. PART 2: EXPERIMENTAL RESULTS

G. Seibert Apr. 1969 63 p refs
(ESRO-TN-91) Avail: CFSTI

The experimental part of an investigation is presented on increasing the solar-cell output by improved optical matching of the silicon solar cell system. Using a glass prism and a grating spectrometer, measurements were made of the reflection from solar cells from different manufacturers and SiO-coated and uncoated silicon wafers with smooth and rough surfaces. In addition, the refractive indices and dispersion curves of the two most commonly used cover-slip adhesives were determined. Two materials, ZnS and TiO2, were selected for the experimental investigation of optimum antireflection layers. It was found that the refractive index of a ZnS film (2.35 at 6000 A) is very close to the optimum (2.4). The ZnS coating had an adverse effect on the photovoltaic properties (series resistance) of n-on-p silicon solar cells, although a ZnS layer increased the short-circuit current by 6 to 7 percent. ESRO

N70-23285*# Pennsylvania Univ., Philadelphia. School of Chemical Engineering.

STUDY OF ZINC-SILVER OXIDE BATTERY SYSTEM Quarterly Report

Leonard Manis Feb. 1970 10 p Prepared for JPL
(Contract NAS7-100; JPL-952543)
(NASA-CR-109347) Avail: CFSTI CSCL 10C

Progress in the electrode studies emphasizing the silver oxide electrode is reported. The product of leaching of silver peroxynitrate (Ag7O8 NO3) in distilled water at room temperature was shown by X ray diffraction to be AgO. Progress in the transport parameters study is also reported. Use of the rotating disk method for permeation studies of zincate through polyethylene separator material is justified because of solution side mass transfer resistance in the viscous electrolyte. Permeability of 0.000077 cm/sec at 25 C in 0.4 M ZnO 40%-KOH was found. Diffusivity of zincate ion, measured by the capillary method, is independent of concentration (0.02 to 0.4M) and is 0.00000303 sq cm/sec at 20 C, and 0.00000324 sq cm/sec at 25 C. Author

N70-23280*# Monsanto Research Corp., St. Louis, Mo.

STUDY OF FUEL CELLS USING STORABLE ROCKET PROPELLANTS Final Report, 18 Aug. 1965 – 23 Jun. 1969

Roger F. Drake, C. N. Satterfield, J. O. Smith, J. C. Orth, L. F. Athearn et al Feb. 1970 194 p refs
(Contract NAS3-6476)
(NASA-CR-109324; MRB-5009F) Avail: CFSTI CSCL 10B

The investigation of fuel cells to operate on gaseous nitrogen tetroxide and Aerozine-50 as direct reactants, with the capability to use these reactants to produce oxygen- and hydrogen-rich feed streams for fuel cells is reported. The advantages of operating fuel cells on storable propellants are shown to include the availability of reactants during space mission from propellant tank residuals and the resulting system weight and volume reductions because separate tankage is not required; and cryogenic storage is not required. F.O.S.

N70-23319*# General Electric Co., Philadelphia, Pa. Missiles and Space Div.

POWER CONDITIONING EQUIPMENT FOR A THERMOELECTRIC OUTER PLANET SPACECRAFT Quarterly Technical Report, 1969

Robert Andrews, Roman W. Andryczyk, Joel K. Baker, Frank R. Barry, Lloyd Brown et al 15 Feb. 1970 215 p refs Prepared for JPL
(Contract NAS7-100; JPL-952536)
(NASA-CR-109321; Rept-1J86-TOPS-513; QTR-4) Avail: CFSTI CSCL 10B

Breadboard circuits were built and tested including quad redundant switching devices, quad redundant shunt regulators, high voltage conversion for TWT's, and microcircuit packaging. Power system studies have resulted in the tentative selection of DC distribution on a single bus with overcurrent and undervoltage protection features. Author

N70-23367*# Electric Storage Battery Co., Yardley, Pa. Carl F. Norberg Research Center.

HEAT STERILIZABLE IMPACT RESISTANT CELL DEVELOPMENT Quarterly Report, 1 Jul. – 30 Sep. 1969

G. F. Nordblom and A. M. Chreitzberg Jan. 1970 41 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951298)
(NASA-CR-109359) Avail: CFSTI CSCL 10C

Electrochemical studies covered three areas: the embrittlement of silver grids, life cycle testing of cells, and tear-down inspection of failed cells. Grid embrittlement of both positive and negative grids is related to the redistribution of negative active material with cycling. For cells that were cycled a limited number of times the grids appear to remain flexible if the cells are left in the charged condition either on stand or float for several weeks or longer. This could be due to the partitioning of available mercury between the small mass of the silver grid and the large mass of charged zinc. Cells in the discharged condition have little zinc to hold the mercury and thus more mercury is available to embrittle the silver. The exaggerated shapes of the cell cavity were without effect on cycle life, but the results of tear-down inspection indicated that the normal redistribution of zinc to the bottom of the electrode may be due more to the case being tighter at the bottom than to the effect of gravity. A case which was smaller at the top than at the bottom caused the zinc to accumulate at the top. Tapered sleeves or shims inserted into regular cases could be used to maintain uniform distribution of active material. Author

N70-23430*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PRELIMINARY PERFORMANCE OF A BRAYTON-CYCLE-POWER-SYSTEM GAS LOOP OPERATING WITH KRYPTON OVER A TURBINE INLET TEMPERATURE RANGE OF 1200 F TO 1600 F

Alfred S. Valerino, Robert P. Macosko, Armen S. Asadourian, Thomas P. Hecker, and Roman Kruchowy Mar. 1970 35 p refs
(NASA-TM-X-52769) Avail: CFSTI

Performance of a krypton gas power loop with a Brayton single-shaft rotating unit and heat-exchanger unit indicated an estimated loop net efficiency and gross alternator power output of approximately 30 percent and 12 kilowatts respectively at a turbine inlet temperature of 1600 F, a compressor discharge pressure of 37 psia and a compressor inlet temperature of 55 F. At a turbine inlet temperature of 1140 F, a compressor discharge pressure of 52 psia and a compressor inlet temperature of 100 F, the estimated net efficiency and gross alternator power were reduced to approximately 7 percent and 4 kilowatts respectively. Author

N70-23527*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FLEXIBLE ELECTRICAL CONDUCTORS FOR HIGH TEMPERATURE SWITCHGEAR

Lawrence A. Mueller and William E. Snider Washington Apr. 1970 20 p refs
(NASA-TM-X-1986; E-5403) Avail: CFSTI CSCL 09A

The design, material selection, and mechanical testing of

an arch-shaped flexible conductor were investigated. The conductor was designed for a 600-kVA ac breaker operating at 1000 F in a space vacuum. A conductor assembly, with the conductors fabricated from Cube alloy (Cu −0.5 BeO), was successfully tested at 1200 F for 1000 hr in a vacuum of 0.000001 torr. During this test, the assembly was mechanically flexed 1000 times, simulating 1000 breaker operations. Author

N70-23598*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Dept.
CYCLE LIFE TEST: EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS Annual Report, Period Ending 14 Dec. 1969
D. E. Mains 6 Mar. 1970 240 p
(NASA Order W-12397)
(NASA-CR-109409; QE/C-70-173; AR-6) Avail: CFSTI CSCL 10C

This annual report covers the cycle life test of the evaluation program of secondary spacecraft cells, through 14 December 1969. The purpose of the acceptance tests is to insure that all cells put into the life cycle program meet the specifications outlined in the respective purchase contracts. A limited number of cells of each type are subjected to the general performance tests to determine their actual capabilities. This evaluation program gathers specific information concerning cell performance characteristics and limitations which is used by spacecraft power systems planners, designers, and integration teams. Weaknesses discovered in cell design are reported and aid in research and development efforts toward improving the reliability of space batteries. Author

N70-23712# European Space Research and Technology Center, Noordwijk (Netherlands).
CALIBRATION OF STANDARD SOLAR CELLS ON THE JUNGFRAUJOCH (3600 METRES)
K. H. David and H. Echternach Dec. 1968 35 p refs
(ESRO-TN-35) Avail: CFSTI

Solar cell calibration experiment was conducted on the Jungfraujoch at an altitude of 3600 m. Included in the calibration experiment were 31 solar cells; ten of these were covered with interference filters and two cells were thin-film CdS cells. A comparison with calibrations obtained by other methods indicated that the accuracy of the Jungfraujoch values was about 2%. It was found that measurements in previous experiments at Locarno and on board a balloon were affected slightly by scattered light. The wavelength dependence and the amount of atmospheric absorption were derived. Atmospheric attenuation effect on the short-circuit current of solar cells was found to be of the order of only 8 to 10% per unit relative air mass, which is about half that found under good conditions at Locarno. Author (ESRO)

N70-23713# European Space Research and Technology Center, Noordwijk (Netherlands).
INTEGRATION OF SOLAR CELLS INTO MODULES
G. Seibert Aug. 1969 18 p refs Presented at the 6th ESRO Summer School, Noordwijk, Neth., 1968
(ESRO-TM-108) Avail: CFSTI

Problems associated with the layout and construction of silicon solar cell modules are discussed. The advantages and disadvantages of different kinds of module mounting are presented. The physical properties of interconnector and contact materials commonly used are reviewed, and a weight breakdown is given of a module representing the current state of the art in Europe. The transmittance degradation of cover slips and adhesives in an electron, proton, and ultraviolet environment is assessed, and the optical matching problems of the solar cell complete system and cover slide are discussed. Author (ESRO)

N70-23788# Royal Aircraft Establishment, Farnborough (England).
A TRANSIENT GENERATOR
J. J. Todman Mar. 1969 20 p refs
(RAE-TM-WE-1297) Avail: CFSTI

A transient generator was developed to produce controlled transient conditions on a 28 volt dc supply. These transient conditions are based on those stated in the British Standards Specification, but the equipment is flexible and is intended to simulate conditions expected in a weapon where a noisy or poorly regulated power supply may be used as the power source for the electronic fusing system. Author (ESRO)

N70-23828# Technische Univ., Berlin (West Germany). Inst. fuer Flugfuehrung und Luftverkehr.
INVESTIGATION OF THE INFLUENCE OF OPERATIONAL CONDITIONS ON THE PERFORMANCE OF SERVO VALVES AND ACTUATORS [UNTERSUCHUNGEN DER EINFLUESSE DER BETRIEBSBEDINGUNGEN AUF DAS LEISTUNGSVERHALTEN VON SERVOVENTILEN UND STELLSYSTEMEN]
Edgar Roessger and Hans-Edgar Kallies Dec. 1968 205 p refs In GERMAN Sponsored by Senator fuer Wirtsch., Berlin
(Rept-48) Avail: CFSTI

The dynamic response and the design of servo-valves and the associated torque motors are discussed in detail, taking into account the performance characteristics of servo-valves, the influence of valve contamination, and the problem of aeration in hydraulic systems. Electric and hydraulic actuator and automatic control systems are compared as regards their efficiency and weight requirements, and the optimum design of orifice plate valves is also discussed. ESRO

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N70-22553# Notre Dame Univ., Ind. Lobund Lab.
BIBLIOGRAPHY OF GERMFREE RESEARCH, 1885–1963, 1968 SUPPLEMENT
Bernard A. Teah May 1969 34 p
(Contract Nonr-1623(15))
(AD-698828) Avail: CFSTI CSCL 6/3

A bibliography of 402 references concerning germfree research for the year 1968 is presented. TAB

N70-22555# Syracuse Univ., N.Y. Dept. of Electrical Engineering.
INTRODUCTION TO BIOLOGICAL QUANTUM MECHANICS
Stanford Goldman 28 Oct. 1969 83 p refs
(Contract N00014-67-A-0378-0002)
(AD-698824; EE-1607-69-10T1) Avail: CFSTI CSCL 6/3

There are observables and eigenstates in biology as well as in physical quantum mechanics. Furthermore, the basic principle of quantum mechanics that measurement of an observable of a physical system will find the system in an eigenstate of the observable holds for biological as well as physical observables. There are transforms domains and representations in biology as well as in physics and there is a striking correspondence between their properties. An organism struggles to maintain the coherence of its individuality throughout its body. This is a means whereby it carries out the struggle for survival and is a fundamental law of biology. The biological phenomenon of alternation of generation serves as a basis for showing that there are biological analogues of bosons and fermions. An organism acts as a boson-analogue in interactions with the environment, while the fermion properties of the gametes regulate the organisms internal characteristics. DNA acts in the manner of a hologram to modulate the life activity of an organism. In the alternation of generations, the organism (somaton) acts as a boson analogue. It interacts with the environment and grows in

mass and complexity, but gradually shows signs of disorganization (noise). It is the extrovert generation. The sperm and ovum (gametons) act as fermion analogues. Their generation is characterized by rejuvenation, noise reduction and growth in numbers. It is the introvert generation. Author (TAB)

N70-22689# Scientific Translation Service, Ann Arbor, Mich.
THE STATE OF WATER IN SUBSTANCES PARTICIPATING IN PHOTOSYNTHESIS [O SOSTOYANII VODY V VESHESTVAKH, PRINIMAYUSHIKH UCHASTIE V PROTSESSE FOTOSINTEZA]
A. V. Karyakin et al Oct. 1969 11 p refs Transl. into ENGLISH from Biofizika (USSR), v. 14, no. 2, 1969 p 240–244 Sponsored by AEC Prepared for ANL
(PB-187229T; ANL-Trans-780) Avail: CFSTI CSCL 06A

The energy of the stronger bond of water molecules in chlorophyll a is found to be 0.7–0.8 kcal lower than that in chlorophyll b. The energy of the hydrogen bond of water is calculated in the substances inorganic phosphates (P), adenosinediphosphate (ADP), nicotinamide-adenine-dinucleotide (NAD), nicotinamide-adenine-dinucleotide-phosphate (NADP) which participate in the process of photosynthesis and it is found that in these substances water forms stronger bonds than in chlorophyll. The compounds studied contain no nonhydrogen-bound OH groups. It is suggested that water is ready to undergo dissociation as a result of the formation of its complex of the type A...H - O-H...B. Author (USGRDR)

N70-22775# Scientific Translation Service, Ann Arbor, Mich.
QUANTUM YIELD OF THE PHOTOREDUCTION OF CHLOROPHYLL AND RELATED COMPOUNDS [KVANTOVYI VYKHOD REAKTSII FOTOVOSSTANOVLENIYA KHLOROFILLA I RODSTVENNYKH SOEDINENII]
I. M. Byteva et al Oct. 1969 13 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 14, no. 3, 1969 p 441–446 Sponsored by AEC Prepared for ANL
(PB-187231T; ANL-Trans-781) Avail: CFSTI CSCL 06A

The quantum yield of the photoreduction of chlorophyll a and its related compounds was measured in the investigation. The dependence of the quantum yield on the light intensity, wavelength of light, the concentration of the pigment and of the reductant was studied. The reaction was found to be a single-quantum reaction. Author (USGRDR)

N70-22895# Baylor Univ., Houston, Tex. College of Medicine.
MEDICAL RADIATION INFORMATION FOR LITIGATION
Stewart C. Bushong, John L. Cox (Houston Univ.), Vincent P. Collins (Rosewood General Hospital), John B. Neibel (Houston Univ.), and George B. Murphy (U.S. Public Health Service) Jul. 1969 402 p refs Presented at Conf. held at Houston, Tex. 21-22 Nov. 1968 Prepared in cooperation with Houston Univ.
(Contract PHS CPE-R-69-01)
(PB-187697; DMRE-69-3) Avail: CFSTI CSCL 06R

A two day conference explored the feasibility of collecting and maintaining records of medical radiation exposure for purposes of potential litigation. The first day of this conference related to medical and scientific factors involved in radiation dosages, disease responses, monitoring instrumentation and records keeping. The second day of the conference related to litigation aspects of tort and workmen's compensation liability, causal and proof problems, factors pertinent to litigants and the application of current legal doctrines to the problem. Author (USGRDR)

N70-22956# Atomic Energy Commission Research Establishment, Riso (Denmark). Health Physics Dept.
ENVIRONMENTAL RADIOACTIVITY IN GREENLAND IN 1968
A. Aarkrog and J. Lippert Jul. 1969 18 p refs
(RISO-203) Avail: CFSTI

Measurements of fall-out radioactivity in Greenland in 1968 are reported. Sr-90 (and Cs-137 in most instances) was determined in samples of precipitation, sea water, vegetation, animals, and drinking water. Estimates of the mean contents of Sr-90 and Cs-137 in the human diet in Greenland in 1968 are given. Author (ESRO)

N70-22970# Atomic Energy Commission Research Establishment, Riso (Denmark). Health Physics Dept.
ENVIRONMENTAL RADIOACTIVITY IN DENMARK IN 1968
A. Aarkrog and J. Lippert Jun. 1969 82 p refs
(RISO-201) Avail: CFSTI

Fallout radioactivity measurements are presented. Sr-90 was determined in samples from all over the country of precipitation, soil, ground water, sea water, grass, dried milk, fresh milk, grain, bread, potatoes, vegetables, fruit, total diet, drinking water, and human bone. Furthermore, Sr-90 was determined in local samples of air, rain water, grass, sea plants, fish, meat, and human milk. Cs-137 was determined in milk, grain products, potatoes, vegetables, fruit, total diet, meat, and human milk samples, and Cs-137 was measured by wholebody counting in persons from a control group at Riso. Estimates of the mean contents of radio strontium and radio cesium in the human diet are given. The gamma-background was measured regularly at locations around Riso, at ten state experimental farms, in an area in Sealand, one in Jutland where future nuclear power plants might be located, and along the shores of the Great Belt. Surveys of environmental samples from the Riso area are included. Author (ESRO)

N70-22973*# HEM Research, Inc., Rockville, Md.
HEM RESEARCH Final Report
[1969] 41 p
(Contract NAS9-8780)
(NASA-CR-108306) Avail: CFSTI CSCL 06C

Preparation and shipment data are given for frozen 'green' monkey kidney and human embryonic kidney and lung cell stocks for the Lunar Receiving Laboratory. Ampoules of these cells were shipped under liquid and vapor phase nitrogen. S.S.

N70-22977# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF PHASE INTERVAL IN THE DIAGNOSTIC PROBLEM
M. L. Bykhovskii 29 Jul. 1969 10 p refs Transl. into ENGLISH from Eksperim. Khirurg. i Anesteziologiya (USSR), v. 7, no. 2, 1962 p 16–19
(AD-698513; FTD-HT-23-244-68) Avail: CFSTI CSCL 6/5

A phase space for describing normal or pathological states of the organism was introduced previously. The points in this space describe the state of the organism and the trajectories describe the dynamics of development. Individual domains of this space represent different groups of states which are defined as different nosological forms. The author introduces the concept of a phase interval, which forms the basis for the possibility of creating a logic of the diagnostic process which is distinct from the probability logic which was outlined previously. TAB

N70-23006# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
RADIO INDUCED ABERRATIONS IN CHROMOSOMES: POSSIBILITY OF USING SOME BIOLOGICAL DOSIMETERS FOR MEASURING IONIZING RADIATIONS IN MAN [ABERRAZIONI CROMOSOMICHE RADIO-INDOTTE: POSSIBILITA D'IMPIEGO QUALI DOSIMETRI BIOLOGICI DELLE RADIAZIONI IONIZZANTI NELL'UOMO]
N. Vulpis and E. Strambi 1969 62 p refs In ITALIAN
(RT/PROT(69)20) Avail: CFSTI

An important aspect of radiation pathology is the examination of chromosome aberrations after irradiation in vivo and in vitro. During recent years the development within the field of cultivation

and preparation technique has made it possible to carry out chromosome studies on human cells. In fact, it is only in the last years that an increasing number of papers concerned with radiation-induced chromosome aberrations appeared. These papers are divided into two groups: chromosome studies after irradiation in vivo and irradiation in vitro. Several reports were based chiefly on studies of peripheral blood from patients given X-ray treatment for ankylosing spondylitis or malignant diseases. Chromosome aberrations appearing after diagnostic roentgen irradiation or radioactive iodine were also described. Other reports were concerned with chromosome investigations of humans who received accidential irradiation in connection with nuclear accidents. Finally chromosome aberrations appear to have been found in humans who are exposed constantly to occupational irradiation. The authors discuss the possibility of employing the dose-effect relationship established for the two-hit aberrations (dicentrics and rings), as the basis of human biological dosimetry. Author

N70-23260# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.

SOME OBSERVATIONS ON ALGAE INVADING A CS 137 CONTAMINATED POND

Janet R. Dugle and J. E. Guthrie Jan. 1970 16 p refs

(AECL-3463) Avail: CFSTI; Atomic Energy of Can., Ltd., Chalk River: $0.50

A comparison of the species of algae found at various collection sites within two ponds, one contaminated with Cs-137, was made in October, 1968. Data on pond surface and bottom temperatures, algae, microfauna, and taxa are presented. It is felt that these ponds provide convenient ecosystems for studying the effects of chronic irradiation on natural aquatic communities and on the succession of such communities. Author

N70-23290*# National Aeronautics and Space Administration, Washington, D.C.

CO2: CHEMICAL, BIOCHEMICAL, AND PHYSIOLOGICAL ASPECTS

Robert E. Forster (Pennsylvania Univ.), John T. Edsall (Harvard Univ.), Arthur B. Otis (Florida Univ.) and F. J. W. Roughton (Cambridge Univ.), eds. 1969 242 p refs Symp. held at Haverford, Pa., 20-21 Aug. 1968

(NASA-SP-188) Avail: SOD $2.75; CFSTI CSCL 06A

Reaction kinetics of carbon dioxide with buffer systems are studied. Equilibria and velocity constants for carbamates of simple peptides and of hemoglobin are determined and the elimination of carbamate formation through blocking of terminal alpha-amino groups in hemoglobin is described. Amino acid sequences of carbonic anhydrases are being studied and used to determine enzymic carboxylation processes. Also reported is research in carbon dioxide pressure equilibration between alveolar gas and capillary blood. For individual titles see: N70-23291 through N70-23317.

N70-23297*# Dundee Univ. (Scotland).

KINETICS OF CARBAMINO COMPOUND FORMATION IN RED CELLS AND IN HEMOGLOBIN SOLUTIONS

J. C. Kernohan, F. J. Roughton (Cambridge Univ.) *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 61–64 refs (See N70-23290 10-04)

Avail: SOD $2.75; CFSTI CSCL 06A

The continuous-flow rapid calorimeter has been used to measure the rates of reactions involving CO2 in bovine red cells and hemoglobin solutions. In the absence of a carbonic anhydrase inhibitor there is rapid heat evolution after CO2 solutions are mixed with a cell suspension of hemoglobin solution. In the presence of concentrations of acetazolamide sufficient to inhibit the carbonic anhydrase, less heat is evolved. In the latter case the heat evolution is solely due to the formation of hemoglobin carbamino compounds. The rate of formation of these compounds has been calculated; the rate constant for carbamino formation with deoxyhemoglobin is about twice that found for oxyhemoglobin. Some possible reasons for this difference are discussed. No significant difference is found between the rates for cell suspensions and for hemoglobin solutions measured under the same conditions. Author

N70-23311*# London Univ. (England). Royal Postgraduate Medical School

ALVEOLAR-BLOOD PCO2 DIFFERENCES DURING REBREATHING

N. L. Jones and E. J. M. Campbell *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 229–231 ref (See N70-23290 10-04)

Avail: SOD $2.75; CFSTI CSCL 06A

Confirmed are previous findings of a difference in carbon dioxide pressure between alveolar gas and blood during rebreathing at rest and on exercise under conditions of negligible net CO2 movement. The difference is slightly reduced when net movement of O2 as well as CO2 is avoided by rebreathing CO2 in N2, but remains as large as 10 mm Hg in heavy exercise. Author

N70-23312*# State Univ. of New York at Buffalo.

ALVEOLAR TO MIXED VENOUS PCO2 DIFFERENCE UNDER CONDITIONS OF NO GAS EXCHANGE

G. H. Gurtner, S. H. Song, and L. E. Farhi *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 233–246 refs (See N70-23290 10-04)

(Grants NIH-7-F2-HE-23; NIH-834-01A1)

Avail: SOD $2.75; CFSTI CSCL 06A

Carbon dioxide tension differences in alveolar and mixed venous and arterial values under conditions of no gas exchange were studied on dogs. Formed was a hypothesis that in biological systems local carbon dioxide tension is affected by local hydrogen(+) and HCO3(-) concentrations as well as by the carbon dioxide tension of surrounding tissues. If the concentration of H(+) increases in the vicinity of the membrane or the membrane itself, an increase in the association reaction occurs and CO2 tension becomes higher than the bulk phase of the blood. Because one H(+) ion is required to associate with each HCO(-) ion to form a H2CO2 molecule, it is assumed that the major source of H(+) is the dissociation of protein. G.G.

N70-23313*# New Jersey College of Medicine, Jersey City.

PERMEABILITY OF THE ALVEOLAR-CAPILLARY BARRIER TO DISSOLVED CARBON DIOXIDE AND TO BICARBONATE ION

Francis P. Chinard *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 247–256 refs (See N70-23290 10-04)

(Contract AT(30-1)-1394; Grants PHS-HE-02492; PHS-HE-09489)

Avail: SOD $2.75; CFSTI CSCL 06A

The multiple indicator dilution technique has been applied to an investigation of the permeability of the alveolar-capillary barrier to HC-1403(-) and to dissolved C-1402(CO2diss) with T-1824 or Na-22 as vascular indicators and DHO or THO as indicators for the aqueous compartment. Under control conditions the outflow patterns of HCO3(-) and CO2diss cannot be distinguished from each other; the mean transit times are equal to or larger than the mean transit times of simultaneously injected water, and there is invariably prolonged tailing. Recoveries in the blood are about 95 percent for both species. These results are taken as indication of distribution of injected carbon dioxide into the gas phase and randomization of the labeled carbon dioxide among the several chemical species present. After inhibition of carbonic anhydrase by acetazolamide, the curves for HCO3(-) and for CO2diss are very close to those for the vascular indicator; the mean transit times are essentially equal to those of the vascular indicators, but the recoveries of CO2diss are less than of HCO3(-) in blood and about three times larger in expired gas. These facts are taken as evidence of restriction of HCO3(-) to a volume essentially the same as the vascular compartment, in common with other anions. They indicate also that CO2diss crosses the barrier readily. Author

N70-23314*# Pennsylvania Univ., Philadelphia.
SIGNIFICANCE OF CARBONIC ANHYDRASE IN LUNG TISSUE
Arthur B. Du Bois *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 257-259 refs (See N70-23290 10-04)
Avail: SOD $2.75; CFSTI CSCL 06A

Described is the capacity of lung tissue to interact with a surge of carbon dioxide by means of a reaction requiring carbonic anhydrase to possess sufficient speed to accomodate part of the load. The alveolar carbon dioxide reservoir is diluted by inspiration and some of the carbon dioxide gas is removed with each expiration. The lung tissue is not needed to supply carbon dioxide; tissue carbon dioxide only dampens the degree of fluxtuation by 10 or 20 percent. G.G.

N70-23315*# Pennsylvania Univ., Philadelphia.
INFLUENCE OF CARBONIC ANHYDRASE ACTIVITY ON THE EXCHANGE OF CO2 ACROSS THE ALVEOLAR-CAPILLARY MEMBRANE
Richard W. Hyde *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 261-265 refs (See N70-23290 10-04)
(Grants PH5-HE-10324; PHS-HE-4108)
Avail: SOD $2.75; CFSTI CSCL 06A

The dynamics of carbon dioxide exchange between alveolar gas, pulmonary tissues, and capillary blood were studied by inspiring and breathholding of gas mixtures enriched with the stable CO2 isotope and labeled with carbon-13. In the presence of active carbon anhydrase, blood flows determined from the rate of disappearance of acetylene and carbon dioxide were almost identical, indicating that there was little or no alveolar to end-capillary gradient for carbon dioxide. Administration of a large dose of carbonic anhydrase inhibitor produced an alveolar to end-capillary carbon dioxide gradient. G.G.

N70-23316*# Medizinische Forschungsanstalt der Max-Planck-Gesellschaft z.F.d.W., Goettingen (West Germany).
RATES OF CHLORIDE-BICARBONATE EXCHANGE BETWEEN RED CELLS AND PLASMA
Johannes Piiper *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 267-273 refs (See N70-23290 10-04)
Avail: SOD $2.75; CFSTI CSCL 06A

Attempts to determine the rate of processes involved in the equilibration of CO2 between red cells and plasma are reviewed. Measurements using either a thin layer of blood or the rapid reaction technique with filtration have shown that at 37 C the processes are 90 percent complete in 0.13 to 1.1 seconds. Values estimated for pulmonary contact time vary from 0.1 to 2.0 seconds. Comparison of pulmonary contact time values derived from measurement of carbon oxide diffusion at varied oxygenation levels with the kinetics of CO2 transfer between red cells and plasma indicate that the alveolar-capillary CO2 exchange is probably not limited by these processes at rest, but might be during exercise. Author

N70-23317*# Pennsylvania Univ., Philadelphia.
THE RATE OF CO2 EQUILIBRATION BETWEEN RED CELLS AND PLASMA
Robert E. Forster *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 275-286 refs (See N70-23290 10-04)
Avail: SOD $2.75; CFSTI CSCL 06A

Permeability of the red cell membrane to carbon dioxide is the basic factor in determining the rate of exchange for the whole erythrocyte to carbon dioxide. The diffusion of the dissolved gas is apparently very rapid and should not become rate limiting in the red cell. The in vivo rate of carbon dioxide equilibration between the red cell and its ambient medium, plus associated readjustments such as the Bohr shift, depend on chemical reactions and the exchanges of molecules and ions in addition to carbon dioxide. G.G.

N70-23318*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
RELEASE OF MICROORGANISMS FROM SOLIDS AFTER SIMULATED HARD LANDINGS Final Report
R. L. Olson and S. J. Fraser 26 Jan. 1970 105 p Prepared for JPL
(Contract NAS7-100; JPL-952511)
(NASA-CR-109344) Avail: CFSTI CSCL 06M

This investigation was conducted to determine the percentage release of microorganisms from the interior of solids after hard impact. The effect of impact on microbial release and survival was investigated in each of the three test phases. During the first phase, the effect was studied by impacting internally contaminated methyl methacrylate pellets onto stainless steel. The second phase was carried out by impacting contaminated methyl methacrylate pellets into sand; while in the third phase, contaminated epoxy pellets were impacted onto stainless steel. The methyl methacrylate data show the percentage of microbial release to be less than 1% at all four test velocities. An exception to this is seen in the epoxy results. The percentage of total microbial survival after impact is velocity dependent but independent of initial spore concentration. The fact that the total number of organisms surviving impact decreases as the velocity increases is of significance. This decrease in total survivors with an increase in velocity, offsets an otherwise expected increase in released viable organisms as material fracturing increases with velocity. Author

N70-23347*# Agence Tunisienne de Public-Relations, Tunis.
RESEARCH ON THE GEOTROPIC STIMULATION PROCESS. PART 1: THE GEOTROPIC SENSITIVITY OF PLANTS [UNTERSUCHUNGEN UEBER DEN GEOTROPISCHEN REIZVORGANG. TEIL 1: DIE GEOTROPISCHE EMPFINDLICHKEIT DER PFLANZEN]
Hans Fitting Washington NASA Mar. 1970 136 p refs Transl. into ENGLISH from Jahrb. Wiss. Botan. (Leipzig), v. 41, 1905 p 221-330 Sponsored by NASA and NSF
(NASA-TT-F-12579; TT-70-58007) Avail: CFSTI CSCL 06C

A method for measuring the geotropic and heliotropic sensitivity in plants by rotating, and lowering or raising the horizontal axis of a clinostat is described. The optimum stimulation was found to be the horizontal position from the normal position of rest. The horizontal is also the position of optimum stimulation for parallelotropic plant parts. It is concluded that the geotropic threshold of difference for different positions is independent of the duration of the single stimulation, but differs with different angles of deviation. F.O.S.

N70-23417*# Agence Tunisienne de Public-Relations, Tunis.
NEW STUDIES ON THE NECESSITY OF THE DIRECTING INFLUENCE OF THE FORCE OF GRAVITY FOR DEVELOPMENT [NEUE UNTERSUCHUNGEN UEBER DIE NOTWENDIGKEIT DER RICHTENDEN WIRKUNG DER SCHWERKRAFT FUER DIE ENTWICKLUNG]
O. Schultze Washington NASA Mar. 1970 6 p Transl. into ENGLISH from Sitz.-Ber. Physik.-Med. Ges. Zu Wuerzburg (German), no. 3, 1897 Sponsored by NASA and NSF
(NASA-TT-F-12580; TT-70-58004) Avail: CFSTI CSCL 06C

The claim that the stable state of equilibrium of the frog egg able to rotate in its membrane is absolutely necessary for the normal development is discussed, and since gravity is an indispensable factor in reaching the state of equilibrium, it is also considered an absolute necessary requirement. Experiments in which the suspension of the stable state of equilibrium led to disorders in development are mentioned. It is concluded that the general attraction of mass is a necessary force for the development of oviparous animals. F.O.S.

N70-23422*# National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography with Indexes
Feb. 1970 184 p refs
(NASA-SP-7011(73)) Avail: CFSTI CSCL 06E

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N70-23428*# Battelle Memorial Inst., Columbus, Ohio.
STUDIES ON OPTIMIZATION OF TECHNIQUES FOR ENZYME INSOLUBILIZATION Final Report
J. Lynn, D. Emmerling, and R. D. Falb 10 Jun. 1969 63 p refs
(Contract NAS2-4890)
(NASA-CR-73354) Avail: CFSTI CSCL 06A

The attachment of aldolase, glyceraldehyde-3-phosphate dehydrogenase and fructose-1,6-diphosphatase to insoluble polymeric matrices provided stable enzymic catalysts. Studies were performed on the solution stabilities of enzymes and on the reaction of enzymes with model compounds. Insolubilization of these enzymes and the characterization of the enzyme-polymer adducts was investigated. The effect of polar aprotic solvents, substrates and sulfhydryl protective reagents on the solution stabilities of the three enzymes was studied. Model compounds containing functional groups which would be used to attach the enzymes to polymeric matrices were reacted with the enzymes, and the effect on enzyme activity determined. Compounds investigated were maleic anhydride, benzenediazonium chloride, and potassium acetate-Woodward's reagent K adducts. Three different carrier materials, ethylene maleic anhydride p-aminobenzylcellulose and aminoethyl cellulose were used to form enzyme-polymer adducts. Author

N70-23458*# National Aeronautics and Space Administration, Washington, D.C.
DIURNAL RHYTHM OF FUNCTIONS IN HUMANS DURING RESTRICTED MOBILITY [O SUTOCHNOM RITME FUNKTSIY CHELOVEKA V USLOVIYAKH OGRANICHENNOY PODVIZHNOSTI]
N. Ye. Panferova Apr. 1970 13 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 50, no. 6, 1964 p 741–749
(NASA-TT-F-12739) Avail: CFSTI CSCL 06S

Changes in diurnal periodicity of certain functions of human muscle activity under conditions of maximum restriction are studied. It is found that under these conditions the customary diurnal rhythm of body temperature changes. The body temperature remains at one level for a long period of time, and then changes abruptly. The change in diurnal fluctuations of pulse rate, breathing, and blood pressure was less pronounced than the change in body temperature fluctuations. Author

N70-23465*# Agence Tunisienne de Public-Relations, Tunis.
CONCERNING SEVERAL MECHANOMORPHOSES IN THE FERTILIZED FROG EGG DUE TO CENTRIFUGAL FORCE [UBER EINIGE AM BEFRUCHTETEN FROSCHEI DURCH CENTRIFUGALKRAFT HERVORGERUFENE MECHANOMORPHOSEN]
Oscar Hertwig Washington NASA Mar. 1970 10 p Transl. into ENGLISH from Sitz-Ber. Akad. Wiss., Preuss. (Berlin), 1897 p 14–18 Sponsored by NASA and NSF
(NASA-TT-F-12582; TT-70-58006) Avail: CFSTI CSCL 06C

The experiment in which the holoblastic frog egg was transformed into a meroblastic type is described. Freshly fertilized eggs were placed in small test tubes which were then filled with water and corked. The tubes were placed along the centrifuge at distances of 17, 24, 32, and 39 cm from the axis of rotation, and whirled at 145 rpm. for 24 hours. The eggs nearest the axis developed normally, but the eggs farthest out were so disturbed that cleavage of cells no longer took place. The eggs at the middle distances developed up to the blastula stage, which had a completely different appearance from that of a normal egg. Details on the differences are given. When allowed to develop under normal conditions after 24 or 48 hours of centrifuging, the eggs developed into gastrulae, and embryos were formed in which deformities were frequent. Furthermore, upon centrifuging, the blastula acquire a stretched out shape and a special arrangement of cells in rows. N.E.N.

N70-23524*# Naval Aerospace Medical Inst., Pensacola, Fla.
SUSCEPTIBILITY TO ACUTE MOTION SICKNESS IN BLIND PERSONS
Ashton Graybiel 18 Feb. 1970 13 p refs
(NASA Order R-93)
(NASA-CR-109411; NAMI-1100) Avail: CFSTI CSCL 06S

A comparison between blind and normally sighted persons was made to investigate the role of vision in the genesis of motion sickness. A group of twelve persons selected only on the basis of their visual defects were exposed to stressful Coriolis accelerations under standardized conditions. All demonstrated differences in susceptibility to acute motion sickness that bore no relation to their rank order of visual deprivation. Insofar as comparison with a group of normal subjects was made possible, no significant differences in susceptibility were demonstrable. It was concluded that vision is not an essential but rather a secondary etiologic factor in the genesis of motion sickness. This is not incompatible with the fact that symptoms characteristic of motion sickness may be visually induced in the absence of motion. Author

N70-23542*# Agence Tunisienne de Public-Relations, Tunis.
ON THE SPECIFIC LIGHT-RELATED POSITION OF DECIDUOUS LEAVES [ZUR KENNTNISS DER FIXEN LICHTLAGE DER LAUBBLAETTER]
G. Krabbe Washington NASA Mar. 1970 68 p refs Transl. into ENGLISH from Jahrb. Wiss. Botan. (Leipzig), v. 20, 1889 p 211–260 Sponsored by NASA and NSF
(NASA-TT-F-12755; TT-70-58043) Avail: CFSTI CSCL 06C

Nineteenth century experiments designed to investigate the mechanisms of leaf positioning are discussed. It is felt that the phenonmenon of light-related position is a function of a special heliotropic property of the leaves. From the first group of experiments it is concluded that the weight of leaves is incapable of influencing the movement of the leaves. Studies on the significance of light and geotropism for leaf movements indicate that light controls the leaf's movements, and exerts an influence on the stationary leaves. It is also concluded that the geotropic properties of Pelargonia plants are not affected by the influence of light. A last group of experiments show that the leaf surface does not control the movements of the leaf stem in Phaseolus plants, and it is concluded that a force in addition to light is necessary to bring about torsion movements. N.E.N.

N70-23543*# Agence Tunisienne de Public-Relations, Tunis.
RESEARCH ON THE GEOTROPIC STIMULATION PROCESS. PART 2: FURTHER RESULTS WITH INTERMITTENT STIMULATION [UNTERSUCHUNGEN UBER DEN GEOTROPISCHEN REIZVORGANG TEIL 2. WEITERE ERFOLGE MIT DER INTERMITTIERENDEN REIZGUNG]
Hans Fitting Washington NASA Mar. 1970 94 p refs Transl. into ENGLISH from Jahrb. Wiss. Botan. v. 41, 1905 p 331–398 Sponsored by NASA and NSF
(NASA-TT-F-12670; TT-70-58013) Avail: CFSTI CSCL 06C

Investigations on the geotropic effect of intermittent stimulation

and the geotropic presentation period with intermittent stimulation, performed at the turn of the century, are discussed in detail. The fading out of geotropic excitations and the relaxation period are described, and the reciprocal influences of two geotropic stimulations are studied. N.E.N.

N70-23600*# Texas Nuclear Corp., Austin.
LARGE AREA PROTON BEAMS FOR RADIOBIOLOGIC RESEARCH FROM THE NASA-SREL SYNCHROCYCLOTRON. 1: INVESTIGATION OF THE NOMINAL 300-MeV PRIMARY BEAM. 2: INVESTIGATION OF THE NOMINAL 600-MeV PRIMARY BEAM Final Report, Jul. –Dec. 1967
K. R. Blake, L. A. Boles, J. B. Nelson, C. V. Parker, Jr., and C. A. Harris Brooks AFB, Tex. School of Aerospace Med. Dec. 1968 35 p refs Prepared for School of Aerospace Med.
(NASA Order R-44; Contract F41609-67-C-0106)
(NASA-CR-109372; AD-683716; SAM-TR-68-79) Avail: CFSTI CSCL 06R

Measurements have been made of the characteristics of large area proton beams for radiobiologic research from the 600 -Mev synchrocyclotron. Proton beams with energies ranging from 450 to 150 Mev were produced by degrading the nominal 600 -Mev primary beam to the desired energy with the appropriate thickness of aluminum, copper, or lead at the beam transport system exit port. Proton beams with energies ranging from 295 to 30 Mev were produced by degrading the nominal 300 -Mev beam from the synchrocyclotron. In addition, the primary beams were expanded with the quadrupole magnets of the beam transport system, and the characteristics of these beams were investigated. The maximum proton flux and spatial distribution of the flux of the various beam configurations were measured at distances of 5, 10, and 15 feet from the exit port, and the corresponding dose rates in tissue were calculated from the maximum flux values. The intensity profiles of the degraded beams were found to be approximately Gaussian, and measurements of several such profiles indicated that the beams were approximately circular. The profile widths and dose rates were measured for many different configurations. Author

N70-23662# Joint Publications Research Service, Washington, D.C.
CHROMOSOME MUTATIONS INDUCED BY SPACEFLIGHT FACTORS IN BARLEY SEEDS DURING THE CIRCUMLUNAR FLIGHTS OF THE AUTOMATIC STATIONS ZOND 5 AND ZOND 6
N. I. Nuzhdin et al 4 Mar. 1970 17 p refs Transl. into ENGLISH from Zh. Obshchey Biol. (Moscow), no. 1, Jan. –Feb. 1970 p 72–83
(JPRS-49979) Avail: CFSTI

The results of a cytological study of the material carried around the moon showed that spaceflight factors induce chromosome mutations. The effect of spaceflight factors combined with gamma radiation varies with the physiological state of the material and radiation dose. Under some conditions the effect of two factors is additive, while under others irradiation increases the impact of spaceflight factors. Author

N70-23664# Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France).
RADIOCHROMATOGRAPHIC DETERMINATION OF PLASMATIC ADENOSINE DEAMINASE (AD) [DETERMINATION RADIOCHROMATOGRAPHIQUE DE L'ADENOSINE DEAMINASE (AD) PLASMATIQUE]
Jean-Jacques Chivot, Dany Depernet, and Jacques Caen (Inst. de Rech. Sur Les Maladies du Sang, Paris, France) Jan. 1970 19 p refs In FRENCH; ENGLISH summary
(CEA-R-3838) Avail: CFSTI

An adenosine deaminase activity in normal human heparinized platelet-poor plasma which can degradate 0.16 micromole adenosine was measured using a radiochromatographic method. This activity which is suppressed by heating at 56 deg C for 30 minutes, reduced by conservation at –20 deg C after one week, and inhibited by high concentrations of urea, is not affected by dipyridamol and p-hydromercurylbenzoate. The activity is proportional to the quantity of plasma, which is the source of the enzyme, but in the different reactive systems. Author (ESRO)

N70-23670# Technische Hochschule Darmstadt (West Germany). Inst. fuer Meteorologie.
ERRORS IN COMPUTING THE DISPERSION OF ATMOSPHERIC TRACE ELEMENTS: A CRITICAL COMPARISON OF MEASURED AND CALCULATED SULFUR DIOXIDE CONCENTRATIONS [DIE FEHLER BEI DER RECHNERISCHEN ERFASSUNG DER AUSBREITUNG ATMOSPHAERISCHER SPURENSTOFFE: EIN KRITISCHER VERGLEICH EEMESSENER UND BERECHNETER SO SUB 2 -KONZENTRATIONEN]
G. Manier Jan. 1969 32 p refs In GERMAN Sponsored by Hess. Min. fuer Wirtsch. und Verkehr
Avail: CFSTI

The reliability of calculated concentrations often arises in work on the dispersion of trace elements. Consequently, a comparison was made between about 2000 measurements of the SO-2-concentration near a sulfuric acid factory and the calculated concentrations. The agreement was not satisfactory and the reasons are discussed. ESRO

N70-23725*# General Electric Co., Philadelphia, Pa.
A STUDY OF ASEPTIC MAINTENANCE BY PRESSURIZATION
Donald J. Chester, Robert J. Homsey, Maurice E. Long, and John F. Sontowski [1969] 186 p refs
(Contract NAS1-9174)
(NASA-CR-66908) Avail: CFSTI CSCL 06C

A study of aseptic maintenance by pressurization has been conducted. It has been demonstrated that a pressure differential slightly above ambient across a membrane separating two quiescent gas chambers prevents migration of microorganisms through a single microscopic hole against that pressure gradient. Spores of B. subtilis var. niger were aerosolized into a chamber and were presented by gravity to the hole at the bottom of the chamber. The holes, ranging in size from 19 microns to 1887 microns in diameter, were made in .012 inch thick membranes of aluminum. The viable spores which penetrated the hole were captured on an agar medium. A total of 50 tests with pressure differentials ranging from 0.5 inches to 2.0 inches of water resulted in total exclusion of micro-organisms from the detection medium. Author

N70-23744# Joint Publications Research Service, Washington, D.C.
RADIO AND ECOLOGY
Mark Chervyakov et al 11 Mar. 1970 28 p Transl. into ENGLISH of the book "Radio i Ekologiya" Moscow, Znaniye, 1969 p 1–32
(JPRS-50043) Avail: CFSTI

The principles of building equipment and developing methods for radio and hydroacoustical animal tracking are studied. It is shown that if the location of the animal is determined by direction finding only a transmitter is required for the animal installation; when measurement of the distance to the animal is necessary, a responder is required as the autonomous installation. For tracking fish an ultrasonic band of frequencies from 20 to 300 kHz is considered desirable: below these frequencies the use of large transmission equipment affects the animals, and above this frequency there is a strong dampening effect by the water. It is concluded that Ecotelemetry offers information in ecology and bionics to track migratory animals such as the whale. F.O.S.

N70-23761# Naval Submarine Medical Center, Groton, Conn. Submarine Medical Research Lab.
SOME COMPARISONS BETWEEN VISUAL AND AUDITORY

NEUROPHYSIOLOGY
J. Donald Harris and Russell L. Sergeant 2 Sep. 1969 15 p refs
(AD-697952; SMRL-592) Avail: CFSTI CSCL 6/16

A number of concepts and facts from the vision domain are of interest and value to otologists. Not only the similarities but also the differences between the two sensory systems are enlightening. The paper discusses the similar ranges of sensitivity to quanta of energy and the biological mechanisms whereby the physical stimuli are transformed logarithmically, coding of the physical stimulus by single cells in the optic and the auditory nerves, principles of neural integration in the brainstem and midbrain nuclei, the point-to-point relationship between cortical activity and certain aspects of the physical stimulus, the eye and ear as channels of information, and cross-modality facilitation and inhibition. TAB

N70-23784# Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.
TIME-ZONE EFFECTS ON THE LONG DISTANCE AIR TRAVELER
P. V. Siegel, Siegfried J. Gerathewohl, and Stanley R. Mohler Sep. 1969 13 p refs
(FAA-AM-69-17) Avail: CFSTI

Findings are presented on the consequences of rapidly crossing numerous time zones, such as occurs in present-day jet aircraft travel. Conclusions reached by FAA researchers and scientists of other laboratories are included, together with recommendations for overcoming time-zone fatigue. These recommendations are for use by the individual long distance traveler. A practical formula is given which describes how one may compute the rest period following a long distance trip. This period is to enable the biological rhythms to rephase in order that the traveler will be in proper physical and mental condition to pursue his responsibilities. Author

N70-23847# Joint Publications Research Service, Washington, D.C.
PROBLEMS IN BIOPHYSICS
S. Ye. Bresler 20 Feb. 1970 66 p refs Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 98, no. 4, Aug. 1969 p 653–708
(JPRS-49895) Avail: CFSTI

Problem areas in the field of biophysics are surveyed. Among these are: the molecular mechanism of genetic coding, the morphogenesis of the cell from membranes, development and differentiation in the formation of complex organisms, membrane structure and function, and electrical phenomena in membranes and their role in nervous activity. In each problem area, abundant experimental work is reported and comments on the understandings attained are made. Methods are not included. M.H.E.

N70-23855# Joint Publications Research Service, Washington, D.C.
NEW DATA ON THE STEREOSCOPIC FIELD OF VISION OF HEALTHY INDIVIDUALS
B. A. Tremeyt 13 Mar. 1970 6 p Transl. into ENGLISH from Vestn. Akad. Nauk Kaz. SSR (ALMA-ATA), v. 25, Jul. 1969 p 68–71
(JPRS-50068) Avail: CFSTI

Developed was an instrument for stereoscopic examination of the human field of vision that measures meridians and parallels of the visual functions. Photic sensitivities were determined statistically for the points of fixation and combined with the indices of meridians and parallels to construct visual field diagrams. Strong age related differences in normal stereoscopic fields of vision were again confirmed. G.G.

N70-23888*# Wisconsin Univ., Madison. Food Research Inst.
BIOCIDAL EFFECTS OF SILVER Final Technical Report
Dean O. Cliver, William B. Sarles, Wesley K. Foell, and John M. Goepfert Feb. 1970 30 p
(Contract NAS9-9300)
(NASA-CR-108338) Avail: CFSTI CSCL 06T

An investigation to determine if silver ions can kill or inactivate microbial and viral agents in very pure water is reported. The results are to be applied in the design of future spacecraft water systems. Salts of silver were employed in many of these experiments, but silver ions generated by an electrolytic apparatus were used when possible. Silver was assayed by neutron activation analysis. Bacteria employed as experimental models were selected on the basis of tests of previous spacecraft water systems. Viruses were chosen simply to represent a broad variety of agents. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N70-22631# Naval Training Device Center, Orlando, Fla.
THE EFFECTS OF ADAPTIVE STEPPING CRITERION ON TRACKING PERFORMANCE: A PRELIMINARY INVESTIGATION Technical Note
Norris R. Bancroft and James S. Duva Oct. 1969 21 p refs
(AD-698792; NAVTRADEVCEN-TN-3) Avail: CFSTI *CSCL 5/9

The work effort constitutes a preliminary investigation of several important factors in the design and implementation of adaptive training research. Specifically, the effects of using various adaptive stepping criteria upon performance were studied. Comparisons of adaptive and non-adaptive training techniques were also made. Recommendations for a follow-on phase of this work effort have been made on the basis of the findings of this first study. Author (TAB)

N70-22719 Kansas Univ., Lawrence.
ANALYSIS OF A RADIOTELEMETRY SYSTEM FOR TRACKING SMALL VERTEBRATES
Warren Karl Legler (Ph.D. Thesis) 1969 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-21544

In order to achieve practical insights into the various problems encountered in biotelemetric studies, a relatively common reptile, the ornate box turtle, Terrapene ornata ornata, was studied using radio transmitters. These studies were largely devoted to tracking individual turtles carrying small, low power radio transmitters and were carried out at the University of Kansas Natural History Reservation. The studies involved nine individual turtles, some for as long as a year. A number of observations, not involving animals, were made of the propagation of radio signals over short distances in several types of terrain: clear and level, hilly, and covered with trees and brush. Some useful observations of movement patterns and habitat preferences were made possible by the ease with which an animal carrying a radio transmitter can be found. These observations were combined with representative values of transmitter and receiver characteristics to make predictions of the useful transmission ranges of various types and sizes of biotelemetry systems. Dissert. Abstr.

N70-22743*# National Aeronautics and Space Administration, Washington, D.C.
APPLICATIONS OF RESEARCH ON HUMAN DECISIONMAKING
R. Mark Patton, Trieve A. Tanner, Jr., and John A. Swets (Bolt, Beranek and Newman, Inc.), eds. 1970 198 p refs Proc. of a symp. held at Moffett Field, Calif., 31 Jan.–2 Feb. 1968; sponsored by NASA. Ames Res. Center
(NASA-SP-209) Avail: SOD $2.00; CFSTI CSCL 05H

Research into the psychology of decision making included the following topics: Decision making in the manual control of aerospace vehicles; pilot performance; signal recognition as an analog to decision making in limited visibility; simulation training for flight control decision making; controller decisions in space flight; visual and auditory signal recognition; application of decision theory to manual control; decision making in manned space flight; and models for memory. S.S.

N70-22797# General Dynamics Corp., Groton, Conn. Electric Boat Div.

DIVER PERFORMANCE MEASUREMENT: TRANSPORTING NEUTRALLY BUOYANT OBJECTS, MANUAL MOVEMENT OF HEAVY OBJECTS Final Report, 1 Apr. 1968 –31 Mar. 1969

B. G. Andersen, F. L. Allen, and J. C. Lamb 14 Jul. 1969 49 p refs

(Contract N00014-67-C-0447)

(AD-698310; U417-69-066) Avail: CFSTI CSCL 5/10

The report presents the results of the second phase in a program of diver performance measurement. The purpose of the program was to develop and apply measurement techniques to determine a free-swimming divers capacity to transport objects of varying size and weight underwater. Two experiments were conducted during this phase of the program. The first was to measure a divers ability to swim with neutrally buoyant objects of varying size to determine the effects of increased drag on a swimmer. The second experiment consisted of an exploratory investigation of a divers ability to move heavy objects underwater for short distances. Author (TAB)

N70-23380# Human Resources Research Organization, Alexandria, Va.

AN ANALYSIS OF SKILL REQUIREMENTS FOR OPERATORS OF AMPHIBIOUS AIR CUSHION VEHICLES (ACVS) Technical Report

James A. Mc Knight, Patrick J. Butler, and Richard D. Behringer Nov. 1969 61 p refs

(Contract DAHC19-70-C-0012)

(AD-698458; HUMRRO-TR-69-18) Avail: CFSTI CSCL 5/9

The report describes the skills required in the operation of an amphibious Air Cushion Vehicle (ACV) in Army tactical and logistic missions. The research involved an analysis of the ACV characteristics, operating requirements, and environment, and results of a simulation experiment. The analysis indicates that ACV operation is complicated by (a) an inherently slow vehicle response in certain control dimensions, (b) a need for complex control coordinations in performing certain necessary maneuvers, and (c) the ACVs sensitivity to various aspects of the natural and man-made environment. The ACV also poses unique requirements for navigation, maintenance, and collision avoidance. The simulator study showed that ACVs vary considerably in operability as a function of their control configuration and pointed to the need for further attention to the control problem in developing ACV use overland. A training program of from one to three months duration appears necessary to qualify an operator fully. Author (TAB)

N70-23410*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

FLUIDIC TEMPERATURE CONTROL SYSTEM FOR LIQUID-COOLED SPACE SUITS

J. B. Starr and G. L. Merrill Sep. 1969 54 p refs

(Contract NAS9-8249)

(NASA-CR-108330; Honeywell-12128-FR1) Avail: CFSTI CSCL 06K

A control system was developed that would modulate coolant temperature at the inlet of a liquid-cooled garment connected to a spacecraft by an umbilical. This was to be accomplished without the addition of electrical or hydraulic signal lines; rather, signals were to be transmitted via already existing liquid supply and return conduits. The system developed modulates coolant temperature in response to changes in pressure drop across the liquid-cooled garment. Modulation is accomplished within a fluidic temperature controller that would be located in the spacecraft. The controller contains no moving parts, and responds to pressure difference signals of less than 0.1 inch of water. The principal mode considered was manual. Automatic control was considered as an aid in maintaining an acceptable thermal state during complex work situations. Automatic as well as manual operation of the system proved successful. Author

N70-23429*# General American Transportation Corp., Niles, Ill. Research Div.

ONE-MAN FORMALDEHYDE SYNTHESIS SYSTEM Final Report

P. Budininkas and G. A. Remus Feb. 1970 88 p

(Contract NAS2-3889)

(NASA-CR-73432) Avail: CFSTI CSCL 06K

A full-scale formaldehyde synthesis system was designed for a nominal one-man capacity of 200 gm CH_2O/day. The system was fabricated and experimentally tested, and from the data observed a preliminary design for a ten-man system was prepared. In normal operation carbon dioxide, oxygen, and hydrogen gases were fed to the one-man system, using a sodium tetraborate reaction bed, with nitric oxide gas as the catalyst, and formaldehyde and water were generated. These products were removed by adsorption on a bed of silica gel granules. With recycling, all of the carbon dioxide was converted to formaldehyde. The system operated automatically and continuously during short duration runs, and in a manner compatible with zero gravity operation. Author

N70-23443# Texas Technological Univ., Lubbock. Center of Biotechnology, Fatigue and Human Performance.

PERFORMANCE, RECOVERY AND MAN-MACHINE EFFECTIVENESS Semiannual Progress Report, 1 Mar. –31 Aug. 1969

Richard A. Dudek 15 Sep. 1969 36 p refs

(Contract DAAD05-69-C-0102; Proj. THEMIS)

(AD-698444) Avail: CFSTI CSCL 5/5

The report covers the activities of a program designed to generate basic data concerning human performance and recovery within several work systems settings under conditions of varied environments, task demands, motivational levels, and nutritional factors. It is desired to generate from this basic data the solution to real problems and recommended procedures for mans operation under varying conditions of the work system, e.g., work-facilitating period combinations for various task types, duration of tasks, environments, etc., determination of mans ability to participate in continuous military operations, procedures, and methods for improved team training, and optimal work-rest schedules for crews of vehicles in an operational environment. Author (TAB)

N70-23460# Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.

SEAT BELT INJURIES IN IMPACT

R. G. Snyder, W. M. Crosby, C. C. Snow, J. W. Young, and P. Hanson Mar. 1969 25 p refs Presented at the Sesquicentennial Symp. on the Prevent. of Highway Injury, Ann Arbor, 19 –21 Apr. 1967

(AD-698289; FAA-AM-69-5) Avail: CFSTI CSCL 6/5

Although the seat belt has been demonstrated to provide effective reduction of injuries and fatalities in automobile accidents by preventing ejection, a pattern of injuries directly attributable to impingement on the belt itself is becoming evident. This paper surveys the clinical evidence of restraint system injuries, discusses gross biomechanical mechanisms of trauma, and evaluates the potential of four principal types of restraint systems in producing injuries. New results are presented comparing the lap belt, diagonal, three-point, and double torso restraint systems in experimental primate impacts utilizing the 6571st Aeromedical Research

Laboratorys Daisy Decelerator. The double shoulder harness (with lap belt) appears to offer the greatest protection of the systems compared, while the single diagonal belt (without lap belt) has been demonstrated to be the most dangerous type in certain impact situations. A seat belt system properly installed and properly worn still offers the single best protection for the automotive occupant during an impact. Author (TAB)

N70-23583# Harry Diamond Labs., Washington, D.C.
AN AIR-OXYGEN MIXING VALVE FOR VOLUME-CYCLED RESPIRATORS
James W. Joyce, Jr. Aug. 1969 21 p refs
(AD-698459; HDL-TM-69-20) Avail: CFSTI CSCL 6/11

A valve that can deliver breathing gas of variable air-oxygen makeup to respirators has been designed, fabricated, and tested. Test results show that gas mixtures containing 20 to 100 percent oxygen can be obtained with good reliability. The maximum change in the makeup of gas leaving the valve caused by varying test conditions was about 5 percent oxygen. Author (TAB)

N70-23612# Northwestern Univ., Evanston, Ill. Dept. of Biological Sciences
CHEMICAL RANGING AND TRACKING Final Report, 27 Dec. 1967 – 30 Jan. 1969
Robert C. Gesteland Jul. 1969 57 p refs
(Contract DA-ARO(D)-31-124-G991)
(AD-698581) Avail: CFSTI CSCL 6/2

The vertebrate nose is unrivaled in its sensitivity to a wide range of trace chemical substances occurring in air and water. At present there are no useful, broad spectrum instruments suitable for real time-chemical detection and analysis. Significant advances in understanding the chemical basis of the olfactory receptor membrane and in relating the signalling parameters of nervous activity to receptor stimulation were made during the period of this grant. In addition, a comparative histological study turned up a vertebrate nose with very large receptor cells, which should allow one to monitor cell function with intracellular microelectrodes for the first time. Finally, several methods were developed for using an electrochemical cell as an indicator of the presence of trace contaminants in a flowing stream. Author (TAB)

N70-23668# Technische Univ., Berlin (West Germany). Inst. fuer Flugfuehrung und Luftverkehr.
STABILIZATION AND GUIDANCE OF VEHICLES USING PREDICTION METHODS [STABILISIERUNG UND LENKUNG VON FAHRZEUGEN MIT HILFE DER VORANZEIGE]
D. Dey and G. Johannsen Sep. 1969 127 p refs In GERMAN
(Rept-50) Avail: CFSTI

Man and machine, e.g. an aircraft, form a closed control loop. The transfer function of such systems can be improved if the pilot not only knows the momentary value of the regulatory magnitude but also the expected value. The extrapolation into the future can be done with the aid of a Taylor's service. The influence of the prediction under different conditions was measured to obtain quanitative indications of the attained improvement of the control quality. The necessary evaluation of a prediction was studied systematically. The results of these considerations are also applicable to other control problems. Finally, experiments were performed to measure the psychological stress on the human controller. ESRO

N70-23676*# Miami Valley Hospital, Dayton, Ohio.
FUNCTIONAL VERIFICATION OF THE APOLLO URINE TRANSPORT SYSTEM
Bernard J. Katchman and James P. F. Murphy Wright-Patterson AFB, Ohio AMRL Feb. 1969 40 p refs
(NASA Order R-85; Contract AF 33(657)-11716)
(NASA-CR-109331; AD-687148; AMRL-TR-67-166) Avail: CFSTI CSCL 06S

A simulated aerospace study was conducted to assess the biochemical effects of space flight by determining the volume of urine output of each crewman. The Apollo urine transport system (UTS), using a radioisotope, tritium, dilution technique, was tested by four human male subjects. The Apollo UTS met minimum requirements for 14 days even when a single unit was used by four individuals. The best individual performance by a subject gave a ratio of 101.4 plus or minus 4.6%. The overall value for volume measurement from the four subjects was 100.6 plus or minus 4.6%. Any void volume may be calculated by this radioisotope method with the UTS system plus or minus 10% of its volume at the 95% confidence level. One experimental error was the incomplete mixing of the radiosotope, the practicability of this procedure in actual space missions still has to be determined. Author (TAB)

N70-23750# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
A SINGLE NUMERICAL CHARACTERISTIC OF THE QUALITY OF DIAGNOSES [YEDINAYA CHISLOVAYA KHARAKTERISTIKA KACHESTRA DIAGNOZOV]
V. V. Alpatov Jan. 1970 9 p refs Transl. into ENGLISH from Sov. Zdravookhr. (Moscow), v. 22, 1963 p 38–41 Prepared for Lincoln Lab., MIT
(AZT-70-43-RULL) Avail: CFSTI

The use of a correlation coefficient and an index of false diagnoses as single numerical characteristics is proposed to evaluate the quality of disease diagnosis. Author

N70-23751*# Illinois Univ., Urbana. Biological Computer Lab.
A NEW HOMEOSTAT
Michael G. Wilkins 15 Jun. 1968 29 p refs
(Grant NGR-14-005-111; Contract AF 33(615)-3890; Grant AF-AFOSR-7-67)
(NASA-CR-109376; AD-683048; AFOSR-69-0316TR; BCL-8.3) Avail: CFSTI CSCL 6/4

The concept of homeostasis and its relations to control and regulation is briefly discussed and the ideas leading to the concept of the ultrastable hierarchic controller are sketched. Previous electronic realizations of homeostatic controllers are discussed, and a new homeostat is described briefly. The machine, presently under construction, has a number of new and useful features and these are described, together with experiments to be performed when the machine is complete. Author (TAB)

N70-23884# Joint Publications Research Service, Washington, D.C.
SOME PROBLEMS OF NEUROBIONICS
K. O. Ivanov-Muromskyi 12 Feb. 1970 12 p Transl. into ENGLISH from Visnik Akad. Nauk Akrayns'koy RSR (Kiev), no. 7, 1969 p 72–78
(JPRS-49811) Avail: CFSTI

The initial steps in the field of neurobionics, such as creation of artificial neurons, synthesis of neuron networks, and their application to the problem of pattern recognition, are briefly reviewed. Both Soviet and foreign efforts in controlling physical systems by brain waves are surveyed. A model of human decision making is described and applications of the model to computer-aided prognosis of diseases are presented. R.B.

N70-23897*# Aircraft Porous Media, Inc., Glen Cove, N.Y.
[MICROBIAL CONTAMINATION IN SPACECRAFT WATER SYSTEM] Final Report
9 Mar. 1970 22 p refs
(Contract NAS9-9027)
(NASA-CR-108336; H-1360-2) Avail: CFSTI CSCL 06K

A study was conducted to determine the degree of microbial back contamination to be expected from the waste water to the potable water in the Apollo Command Module water system. The study shows that a bacteria removal filter is needed immediately upstream of the potable water tank or immediately upstream of the potable water outlet. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N70-22515 National Lending Library for Science and Technology, Boston Spa (England).
ELECTRODEPOSITION OF COPPER-NICKEL ALLOYS FROM ELECTROLYTES CONTAINING AMMONIA COMPLEXES
V. S. Galinker et al 24 Nov. 1969 5 p refs Transl. into ENGLISH from Adaptive Control Systems (Moscow), 1967 p 304-313
(NLL-Trans-746-330-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The possibility of electrodeposition of copper-nickel alloys from ammonia complex electrolytes in the presence of ammonium chloride was examined. Starting solutions were prepared from ammonia complexes of copper and nickel. Electrolysis was conducted at room temperature and current densities of 0.5-4.0 A/sq dm. The results indicate that raising the relative concentration of nickel in the solutions leads to increased nickel content in the alloy; raising the concentration of copper in the solution, however, brings about a more rapid increase in nickel concentration, i.e., copper is invariably deposited preferentially before nickel. At low current densities, the copper content in the deposit is increased by increasing the total concentration of the metals at an unchanged nickel-copper ratio. By increasing the current density or by increasing the pH, the amount of nickel in the alloy substantially increases. The composition of the copper-nickel alloys is also strongly affected by the electrolysis conditions. S.S.

N70-22518# National Research Council of Canada, Ottawa (Ontario).
THE BENZYL ESTERS OF DESOXYDINUCLEOSIDE PHOSPHATES AND 5'-O-(beta, beta beta)-TRICHLORETHYLPHOSPHORYLTHYMIDYLYL-('-5')-THYMIDYLYL-(3'-5')-THYMIDINE [DIE BENZYLESTER VON DESOXYDINUCLEOSIDPHOSPHATEN UND 5'-O-(beta, beta, beta) TRICHLORAETHYLPHOSPHORYLTHYMIDYLYL-(3'-5')-THYMIDYLYL-(3'-5') THYMIDIN]
K. H. Scheit 1969 5 p refs Transl. into ENGLISH from Tetrahedron Letters (London), no. 23, 1967 p 3243-3247
(NRC-TT-1391) Avail: CFSTI

In the methylation of thymidylyl-(3'-5')-thymidine (I) with diazomethane is observed the occurrence of the methyl ester. The stability of this triester led to the preparation of the corresponding benzyl ester by reaction of desoxyoligonucleotides with phenyl diasomethane and to investigate its properties. Author

N70-22528# Amsterdam Univ. (Netherlands).
CHEMICAL EFFECTS OF NUCLEAR ACTIVATIONS IN PERCHLORO AND PERFLUOROCARBONS
Aad Van Dulmen (Ph.D. Thesis) 1968 100 p refs
Avail: CFSTI

Reactions of hot recoil nuclei in simple organic systems in the liquid and solid state are considered. The recoil activity of carbon tetrachloride, tetrachloroethylene, and hexachloroethane with thermal and fast neutrons is emphasized. The distribution of chlorine- and fluorine-labelled products in the perfluoro- and perchlorocarbons is compared to that of titriated products. The radio gas chromatography equipment used for analysis is described. R.B.

N70-22535# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
BIBLIOGRAPHY OF DOUBLE LAYER STUDIES AT THE POLARIZED LIQUID METAL/SOLUTION INTERFACE
D. E. Broadhead, J. R. Jordan, and R. S. Hansen Jul. 1969 116 p refs
(Contract W-7405-eng-82)
(IS-2131) Avail: CFSTI

The 969 references listed cover the period from 1936 to 1968 and are concerned with the double layer at the polarized liquid metal/solution interface. The report consists of three sections: a bibliography section, an author index section, and a key word out of context index (KWOC index) section. The bibliography section lists the author, the title plus a short abstract, and the source citation for each article. The author index lists the authors' names and the reference numbers of their articles. The KWOC index lists the key words, the reference numbers of the articles in which the key word appears, and the first 100 characters of their titles. Author (NSA)

N70-22538# Brown Univ., Providence, R.I. Dept. of Chemistry.
ISOTOPE STUDY OF THE DECOMPOSITION OF INORGANIC PEROXIDES Final Technical Report, Nov. 1965-Oct. 1969
John O. Edwards Nov. 1969 11 p refs
(Contract AF-AFOSR-1439-68)
(AD-698830; AFOSR-69-3107TR) Avail: CFSTI CSCL 7/2

A brief summary is given for research where isotopic oxygen-eighteen was employed in studies of peroxide decompositions in order to help identify conformation of transition states. For this purpose, a new method was developed for syntheses of double-labeled hydrogen peroxide. The method is based on a gas discharge technique. Initial experiments sought to assess the importance of the steric effect in peroxide decomposition. For this purpose monoperoxophthalic acid was selected. Preliminary studies were made of mechanistic pathways for decomposition of effervescent, magnetic peroxoborate (EMPB). No exchange of peroxidic oxygens with water molecules were observed. Studies have been completed on the decomposition of the tetraperoxochromate (V) ion. Related studies were also made on diperoxotriammine chromium (IV). Author (TAB)

N70-22548# Pittsburgh Univ., Pa.
CAPTURE, LOSS AND IONIZATION CROSS SECTIONS OF IONS AND NEUTRAL PARTICLES Final Report
T. M. Donahue Dec. 1969 4 p refs
(Contract NONR-624(06))
(AD-697963) Avail: CFSTI CSCL 7/4

Experimental and theoretical work was devoted principally to measuring and calculating cross sections for charge changing and ionizing collisions of H(+), H, and H(-) with gas molecules. The scope of the accomplishments achieved during this period is indicated in a list of publications included in the report. TAB

N70-22556# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMODYNAMIC PROPERTIES OF THE GASEOUS DISSOCIATING SYSTEMS Al2Cl6-2AlCl3 (SELECTED ARTICLES)
V. B. Nesterenko et al 22 Aug. 1969 36 p refs Transl. into ENGLISH from Fiz. Tekhnichnykh Nauk (USSR), no. 2, 1967 p 32-55
(AD-698530; FTD-HT-23-299-69) Avail: CFSTI CSCL 7/4

Three articles are presented in the report: (1) The use of a dissociating gas system as the working medium in a closed gas-turbine cycle increases the gas constant in the turbine and decreases it in the compressor, thus increasing the efficiency, compared with cycles using inert gases. The article deals with the Al2Cl6 = 2AlCl3 system. (2) Experimental studies of heat transfer in a chemically reactive gas flow have been carried out. The Nusselt number was used as a function of the Reynolds and Prandtl criteria in a forced turbulent flow in a tube. The experimental unit consisted of a closed loop using a pump for the circulation of N2O4. (3) This article is a companion to the preceding article dealing with heat exchange in the presence of a chemical reaction.

but under equilibrium conditions. The article deals with the modifications that must be made to the calculations when allowance is made for the kinetics of the chemical reaction. TAB

N70-22568# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
THE MERCURY SENSITIZED PHOTODECOMPOSITION OF N2O
R. Simonaitis and Julian Heicklen 15 Oct. 1969 14 p refs *Its* Scientific No. 340
(Grants NSF GA-12358; NSF GP-10829)
(PB-187275) Avail: CFSTI CSCL 07E

At room temperature ground state oxygen atoms react with N2O very much faster than previously thought. The exclusive initial reaction is O (tripletP) + N2O yields 2NO. Author (USGRDR)

N70-22578 National Lending Library for Science and Technology, Boston Spa (England).
MECHANISM OF THE PHOSPHORUS-REDUCTION IN THE FORMATION OF NICKEL-PHOSPHORUS COATINGS
K. M. Gorbunova et al 22 Oct. 1969 6 p refs Transl. into ENGLISH from Zashch. Metallov (USSR), v. 5, no. 2, Mar.–Apr. 1969 p 195–200 In ENGLISH and RUSSIAN
(NLL-Trans-746-308-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The mechanism of the phosphorus-reduction reaction in the electrodeless and electrochemical deposition of nickel from hypophosphite-containing solutions was examined. The phosphorus content of deposits was determined by a molybdate alkalimetric technique. Analysis of solutions for hypophosphite was performed by a cerometric method. The amount of phosphite was computed as the difference between the total phosphite and hypophosphite content and the amount of hypophosphite. Results indicate: (1) With other electrolysis conditions being equal, hypophosphite as a phosphorus source yields higher phosphorus contents of deposits than does an equivalent quantity of phosphite. In the latter case, however, the current efficiency is higher and the external appearance of deposits is better. (2) In the electrolytic process, solution acidity is the most important factor affecting the phosphorus content of deposits. In the same manner, solution acidity influences the electrodeless reduction of metals with hypophosphite. Author

N70-22579# Air Force Cambridge Research Labs., Bedford, Mass.
DIPOLE MOMENTS OF CYCLIC CARBONIC ACID ESTERS
B. A. Arbuzov et al Oct. 1969 11 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Dokl., v. 68, 1949 p 1045–1048
(AD-698332; AFCRL-69-0466; AFCRL-Trans-61) Avail: CFSTI CSCL 7/4

Dipole moments of cyclic esters of carbonic acid in benzene solution are measured and compared with theoretical calculations. Dipole moments are reported for ethylene carbonate (4.80D), 1:3 propylene carbonate (5.21D) and 1:3 butylene carbonate (5.23D). These values are shown to be consistent with theoretically calculated values for the corresponding open chain compounds dimethyl carbonate and diethyl carbonate in the appropriate stereochemical configurations. Author (TAB)

N70-22583 Brigham Young Univ., Provo, Utah.
THE COMPLEX SOLUBILITY OF SILVER CHLORIDE, SILVER BROMIDE, SILVER IODIDE, AND SILVER THIOCYANATE IN MIXTURES OF WATER WITH ETHANOL, METHANOL, ACETONE, AND DIOXANE
Earl Madsen Woolley (Ph.D. Thesis) 1969 152 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-20136

The results of an investigation of the solubilities of the salts in approximately 10, 20, 30, 40, and 50% by weight ethanol-water, methanol-water, acetone-water, and dioxane-water mixtures, and in an approximately 60% by weight dioxane-water mixture at 25 C are presented. A radiotracer technique was used to determine the total silver content of these various solutions saturated with the appropriate slightly soluble silver salt. The results of silver ion specific electrode potential difference measurements in these saturated solutions were used in some of the calculations. Least squares methods of data treatment were used to calculate the values of the thermodynamic equilibrium constants that describe the relationships among the various species in solution. A comparison of the results with the various theories of ionic interactions in solution is made and some of the inadequacies of these theories are discussed. Dissert. Abstr.

N70-22586 Baylor Univ., Waco, Tex.
HYDROGEN EVOLUTION AND PENETRATION INTO IRON
Anne Mo-Yung Wong (Ph.D. Thesis) 1969 191 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-21657

A coulometric technique was used to study hydrogen sorption on the iron electrode in basic solution. From the measurement of the equilibrium potential as a function of hydrogen coverage, it was concluded that both the adsorbed and absorbed species are atomic in nature. It was found that the absorbed hydrogen could be oxidized and reduced inside the metal. In 0.3 M sodium hydroxide, the rate constant for hydrogen absorption was found to be enhanced by the adsorption of sulfide ion and cyanide ion. The rate constant for the diffusion of hydrogen out of the metal was found to be enhanced by adsorption of hydroxide, chloride, sulfide, and cyanide ions. Dissert. Abstr.

N70-22593 Harvard Univ., Boston, Mass.
LONG-RANGE INTERMOLECULAR FORCES
Howard Leigh Kramer (Ph.D. Thesis) 1969 155 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-19800

Combination rules, from which van der Waals coefficients for interactions between unlike molecules may be estimated when those for the corresponding like interactions and the static polarizabilities are known, are presented for two- and three-body dipole force constants and for all the higher multipole terms of the second-order two-body dispersion energy. The rules give excellent agreement when compared with accurate unlike coefficients for systems including H, He, Ne, Ar, Kr, Xe, Li, Na, K, Rb, Cs, Hg, H2, N2, CH4, He(2(1)S), He(2(3)S), He(+), Li(+), K(+), Rb(+), Cs(+). Quantum mechanical oscillator strength sums S(d) are used to find rigorous upper and lower bounds to van der Waals coefficients and to the sums themselves. It is shown that any two sums of any multipole order give a bound to any other sum and either a bound or an estimate for the like force constant for that multipole. Van der Waals coefficients for interactions of Hg with H, rare gases, alkali metals, H2, N2, CH4, metastable heliums, and Hg were calculated. Dissert. Abstr.

N70-22601 Columbia Univ., New York.
A STUDY OF HEISENBERG EXCHANGE FOR ORGANIC FREE RADICALS IN SOLUTION
Nelson L. Smith (Ph.D. Thesis) 1969 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-20190

Heisenberg exchange rate constants k have been measured for potassium anthracenide, sodium anthracenide, lithium anthracenide, potassium tetracenide and potassium naphthalenide in the solvent 1,2-dimethoxyethane. The rate constants were obtained by studying linewidths for well-resolved electron spin resonance spectra as a function of free radical concentration. Optical extinction coefficients were measured for all the systems examined (except potassium tetracenide) to facilitate the concentration measurements. The rate constants were characteristic of a diffusion-controlled reaction between electrically neutral molecules. A temperature study of the rate constant for potassium anthracenide in the range 40 deg to

−80 C revealed that k was linearly dependent on the ratio (t/eta), where T is the absolute temprature and eta is the solution viscosity. It was concluded from these results that the probability of exchange given a collision between a typical pair of potassium anthracenide radicals was nearly 1/2. Dissert. Abstr.

N70-22618 Northwestern Univ., Evanston, Ill.
ISOTOPE EFFECT IN SELF-DIFFUSION IN IRON
Charles Monroe Walter (Ph.D. Thesis) 1968 82 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-7004

The isotope effect in self-diffusion was measured in the delta, gamma and alpha phases of iron using an isotope pair, Fe-52 −Fe-59. The isotope effect data together with measurements taken on the effect of cobalt solute additions on iron self-diffusion were used to deduce the most likely mechanism of self-diffusion in all three iron phases. The strength of the isotope effect in bcc delta-Fe was found to be E = 0.337 + or − 0.007 and if a vacancy diffusion mechanism was assumed delta K = 0.464 + or − 0.009. The best value of E for fcc gamma-Fe was 0.530 + or − 0.015 giving delta K = 0.680 + or − 0.020 for a vacancy mechanism. A value of E = 0.46 + or − 0.04 was found in the bcc alpha-phase with a corresponding delta K = 0.63 + or − 0.06 if a vacancy mechanism was assumed. The isotope effect results are consistent with a vacancy mechanism in gamma-Fe. By applying Lidiard's theory on the effect of solutes on self-diffusion the impurity correlation factor for Co in Fe was found to be 0.81 + or − 0.01 in delta-Fe and 0.83 + or − 0.01 in alpha-Fe suggesting that the same diffusion mechanism was operating in both of these bcc phases. Dissert. Abstr.

N70-22661 Denver Univ., Colo.
MULTIPLE DISPERSION IN HYDROGEN POLYATOMIC GAS MIXTURES
Sidney John Nethery (Ph.D. Thesis) 1968 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-6388

It has been shown that methyl chloride-hydrogen mixtures clearly exhibit multiple velocity dispersion. The relaxation times for the two steps of the dispersion can be related through a parameter N. Values of the parameter N of approximately 4 for mole fractions of hydrogen of about .5 were determined from the measurements. In addition it was shown that normal hydrogen has the same effectiveness as parahydrogen for the vibrational de-excitation of methyl chloride. In all cases it was found that hydrogen is more efficient for causing vibrational transitions in methyl chloride and nitrous oxide and rotational transitions in hydrogen than either methyl chloride or nitrous oxide. Multiple dispersion in nitrous oxide-hydrogen mixtures was not established conclusively. It is pointed out that separations of the relaxation times of no more than 1.8 could be expected. Dissert. Abstr.

N70-22679 Ohio State Univ., Columbus.
SELECTED ASPECTS OF THE CRYSTAL CHEMISTRY OF BaSO4, SrSO4, AND PbSO4
John Charles Butler (Ph.D. Thesis) 1968 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-4854

Twenty seven binary and thirty six ternary samples in the system BaSO4-SrSO4-PbSO4 were investigated by means of a high temperature homogenization technique. Analysis by X-ray diffraction failed to reveal the presence of exsolution gaps, intermediate compounds, or disordered phases. Linear, quadratic, log-log and semi-log relationships were fitted to scatter diagrams of lattice parameters (measured) versus composition. Statistical studies suggest that a linear relationship provides the best fit for the variation of a sub o, b sub o, c sub o, d sub 211, and unit cell volume versus composition. Quadratic relationships provide the best fit to the computed density versus composition variation. Detailed examination of X-ray diffraction powder patterns of partially reacted material suggests that homogenization is attained by a different mechanism in each binary system. A model based on the ratio of the radii of the substituting species and the electronegativity differences appears to be useful in classifying these sulfate solid solutions and their fluoride analogues. Dissert. Abstr.

N70-22682 Louisiana State Univ., New Orleans.
SPECTROSCOPIC STUDIES ON FIRST ROW TRANSITION METAL COMPLEXES IN NON-AQUEOUS SOLVENTS
Edward Frazier King (Ph.D. Thesis) 1969 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-5221

Tetrahedral tetrachloro complexes of vanadium 3, manganese 2, cobalt 2, nickel 2, and copper 2 have been prepared and characterized in a non-aqueous solvent system. Their preparation was accomplished by reacting a benzene solution of a long-chain quaternary ammonium salt with the appropriate anhydrous metal chloride. The visible and far-infrared solution spectra of all complexes were recorded and analyzed. The manganese 2, cobalt 2 and nickel 2 species appear to have regular tetrahedral structures in solution. However, the spectra of the vanadium 3 and copper 2 complexes can only be interpreted in terms of distorted tetrahedral structures. These assignments are based on the excellent agreement of the observed visible spectra with the energies of the transitions calculated from ligand field theory as well as the corroborative evidence provided by the far-infrared spectra. Dissert. Abstr.

N70-22690# California Univ., Los Angeles. School of Engineering and Applied Science.
AN ANALYTICAL STUDY OF THE PRODUCTS OF COLLISIONS OF 1 eV ATOMS WITH CONTAMINATED SURFACES
Kuang-Chi Chiang Sep. 1969 104 p refs
(Grant NSF GK-1854)
(PB-187207; UCLA-69-11) Avail: CFSTI CSCL 07D

A simple classical model of interactions between incident gas molecules and a contaminated surface is proposed. If the energy of the beam particles is sufficiently high, say 1 to 10 eV, then absorbed particles can be dislodged during these interactions. Calculations indicate that, if the adsorption potential varies periodically along the surface, the adsorbed particles are sputtered into a multi-lobular distribution. The positions of the peaks depend on the velocity of the incident particles, the heat of adsorption, the amplitude of the adsorption-potential variation, and the equilibrium adatom-surface distance. For a relatively clean surface, the scattering distributions are nearly diffuse with a prominence in the forward direction. Author (USGRDR)

N70-22706 Johns Hopkins Univ., Baltimore, Md.
A STUDY OF NATURAL AND SYNTHETIC LITHIUM-IRON MICAS
Milan Rieder (Ph.D. Thesis) 1968 272 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 69-8687

Chemical analyses of natural Li-Fe micas indicate that their compositions lie close to the siderophyllite (K2Fe4(+2)Al2Al4Si4O20(OH,F)4)polylithionite(K2Li4Al2SiBO20(F,OH)4) join. The crystallochemical formulas can be calculated so that there are no interlayer vacancies. The octahedral vacancies do not show any clear relation to the chemical composition of the micas. Using a few assumptions, octahedral vacancies can be shown to be created by octahedral and tetrahedral substitutions in the ratio approximately 2:1. Their total number is probably affected by the phases coexisting with the mica. Together with the sizes of octahedral cations, crystallographic properties indicate an ordered arrangement in the octahedral sheet of Li - Fe micas. These micas probably have an octahedral sheet with sites of equal sizes. Dissert. Abstr.

N70-22709# Tyco Labs., Inc., Waltham, Mass.
THE EFFECT OF ADSORBED LAYERS ON THE ANODIC OXIDATION OF SIMPLE ORGANIC COMPOUNDS. 1: TIME VARIATIONS DURING THE OXIDATION OF HCOOH AND THE EFFECT OF ADDED Cl Interim Report
A. H. Taylor, R. D. Pearce, and S. B. Brummer Nov. 1969 19 p refs
(Contract N00014-66-C0210)
(AD-698311; TLI-308; ITR-5) Avail: CFSTI CSCL 7/4

The deterioration of currents with Time (time effects) during the oxidation of 0.1 M HCOOH on Pt electrodes in 1 M H2 SO4 at 40 C has been examined. The effect of added Cl (-) on the HCOOH oxidation rate at 0.65 and 0.75 V (versus Rhe) has been studied. HCOOH oxidation currents have been measured at 0.75 V (versus Rhe) as a function of HCOOH purity. The current decays with time results indicate that this decay is, to a large extent, due to anionic type impurity in the solution. This impurity is present at very low levels and the behavior is similar to that with a solution containing 5 X 10 to the - 7th M Cl (-). Results are reported for HCOOH oxidation at 0.65 and 0.75 V (versus Rhe) as a function of Cl (-) concentration. The reaction is extensively inhibited by increased addition of Cl (-) as a direct consequence of Cl (-) adsorption on the electrode. These observations imply that the electroactive species in HCOOH oxidation at these potentials is HCOO (-). Author (TAB)

N70-22712# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
SPURIOUS THERMOLUMINESCENCE OF SOILS
H. Nishita and M. Hamilton [1969] 21 p
(Contract AT-04-1-GEN-12)
(UCLA-12-757) Avail: CFSTI

Spurious thermoluminescence of six soils differing widely in physical and chemical characteristics was examined. As observed by previous investigators working with other materials, the spurious glow of soils also appeared to be dependent on the oxygen adsorbed on the surface of the luminescent particles. The amount of natural spurious thermoluminescence depended on the kind of soil. Spurious (surface) glow and volume glow were increased considerably by exposing the soils to Co-60 photons. The increase of the surface glow relative to that of the volume glow on irradiation depended also on the soil. One soil examined showed that it is possible to obtain the increase of surface glow on irradiation without the formation of detectable amounts of volume glow. Except for one soil, the volume glow of the soils exposed to Co-60 photons occurred predominantly in the low temperature range, while the surface glow occurred predominantly in the high temperature range. The large amount of volume glow induced in soil No. 4FF by irradiation appeared to be due to its high lime content. Author (NSA)

N70-22716# Virginia Polytechnic Inst., Blacksburg. Dept. of Chemistry.
A: THE HYDROGEN FLUORIDE SOLVENT SYSTEM. B: MOESSBAUER STUDIES ON RARE EARTH COMPOUNDS Annual Report
A. F. Clifford Aug. 1969 42 p refs
(Contract AT(40-1)-3603)
(ORO-3603-4; AR-3) Avail: CFSTI

A number of europium compounds were investigated by Eu-151 Mossbauer spectroscopy, including Eu2Zr2O7, Eu2Si2O7, Eu2Sn2O7, and EuPO4. The last has the smallest linewidth of any known oxy compound of europium. Incipient quadrupole splitting was found in some of the others. Correlations were made on isomer shift and ionicity, on linewidth and crystal structure, and on absorption efficiency and rigidity of crystal structure. Isotherms were investigated at a temperature of 500 C and below, and at oxygen pressures from 0.00001 mm to an upper limit of approximately 200 mm. A quartz beam microbalance enabled the continuous observation of small changes in the stoichiometry of the praseodymium oxide observed as a function of the oxygen pressure applied to the oxide. All of the isotherms exhibited stoichiometry hysteresis. Author (NSA)

N70-22722 Kansas State Univ., Manhattan.
INFRARED CHEMILUMINESCENCE FROM H + SCl2, H + S2Cl2, H + SOCl2 and H + SO2Cl2
Richard L. Johnson (Ph.D. Thesis) 1969 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-21128

A study was made of the IR chemiluminescence from Hatom reactions with a series of molecules having the sulfur chlorine bond. The H + Cl2 reaction was used as an internal standard to estimate the effect of relaxation processes on the original vibrational state distributions. With this internal standard technique each sulfur chloride experiment is compared to one with Cl2. The emission lines of the fundamental transitions were analyzed to obtain the relative vibrational-rotational state populations. A comparison of the known initial and observed steady state distributions for H + Cl2 shows that under the experimental conditions of the present study collisional (gas phase and wall) relaxation processes degrade the initial vibrational state distributions. Dissert. Abstr.

N70-22731 Pennsylvania Univ., Philadelphia.
DISSOLUTION OF BINARY HOMOGENEOUS ALLOYS
Barry Theodore Rubin (Ph.D. Thesis) 1969 334 p
Avail: Univ. Microfilms: HC $15.10/Microfilm $4.30 Order No. 69-21421

The electrodic dissolution kinetics of each component dissolving from the copper nickel alloy matrix has been studied as a function of electrode potential, temperature, time, and alloy composition. The methods employed in this study may be broadly categorized in two parts: electrochemical techniques and optical techniques. In the electrochemical approach one utilized polarographic methods to analyze the partial currents of each component dissolving from the alloy under an applied potential. In the optical approach, interferance contrast and interferometric techniques were employed along with electron microscopy to monitor the surface topography before and after the dissolution process. Moreover, employing lapse photography , the dissolution process was recorded in situ. A linear dependence of the current density of each dissolving alloy constituent with potential was found. The rate constants for the dissolution of each component when charge transfer is rate controlling were calculated as a function of alloy composition. Dissert. Abstr.

N70-22732 North Carolina State Univ., Raleigh.
RADIATION-INDUCED PRODUCTION OF DIBUTYLTIN DIBROMIDE AT HIGH TEMPERATURES
Donald Fhay Hallman (Ph.D. Thesis) 1968 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-7676

Experiments were conducted to determine the characteristics of the radiation-induced reaction between tin metal and 1-bromobutane to temperatures of 220 C. The reaction was performed in a pyrex reaction vessel; the 1-bromobutane was kept in the liquid phase at high temperatures by an over-pressure of inert gas. The effects of temperature, pressure, dose, dose rate, and 1-bromobutane concentration were studied. It was found that the reaction showed no pressure dependence; yields increased with temperature to 160 C, and decreased rapidly above 160 C. Dose rate data indicates that the reaction for production of dibutyltin dibromide has a trimolecular termination step. Based on the experimental data, an industrial plant was designed for the production of dibutyltin dibromide. The manufacturing costs for this plant were $1.707 per pound of dibutyltin dibromide, FOB plant. The cost contribution of the radiation source and radiation-related equipment were $0.011 per pound. Dissert. Abstr.

N70-22733 Montana State Univ., Missoula.
STRUCTURAL STUDIES OF CYCLIC ORGANIC PHOSPHORUS COMPOUNDS
Duane Douglas Swank (Ph.D. Thesis) 1969 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-20128

Acetonanediol cyclophosphate crystallizes in space group (P2 sub 1)/n with a = 7.755A, b = 9.446A, c = 10.345A, beta = 99.65 degrees. The ring system is planar and the methoxy group lies directly above the ring with the carbon atom centered between the two ring oxygens. The PO3(C6H5)4(C6H4Br)C5H2 crystallizes in space group (P2 sub 1)/c with a = 9.432A, b = 15.854A, c = 19.094A, beta = 102.01 degrees. The five-membered ring is planar and the trigonal bipyramid is little distorted. The more electronegative atoms occupy axial positions, while the carbon atoms occupy the equatorial positions 2,3,4-trimethylpentane-2,4-phosphinic acid monohydrate crystallizes in space group C2/c with a = 13.251A, b = 6.511A, c = 26.387A, beta = 101.46 degrees. The four-membered ring is slightly bent to form a very shallow V and is very highly strained. The phosphoryl oxygen is hydrogen bound to a water molecule across the two-fold screw axis and to the screw related water. Dissert. Abstr.

N70-22745 Rensselaer Polytechnic Inst., Troy, N.Y.
A MASS SPECTROMETRIC STUDY OF VAPOR-SOLID INTERACTIONS
Anwar Ali Kinawi (Ph.D. Thesis) 1969 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-13685

The interaction of mercury vapor with a pyrex glass surface was undertaken with the purpose of elucidating some of the factors affecting the nucleation rate of metal vapors on non-metallic substrates. A high vacuum mass spectrometric technique was used to measure the thermal accommodation coefficient (TAC) and the critical supersaturation required for the nucleation of mercury vapor on rigorously degassed, carbon monoxide contaminated and water contaminated pyrex glass substrates. Measurements were executed by observing, mass spectrometrically, the mercury vapor flux leaving a substrate exposed to mercury vapor of fixed temperature (near ambient) and pressure. Impurity effects on the TAC of mercury on degassed surfaces were found to depend on the nature of the impurity. Water contaminated surfaces showed perfect accommodation in the substrate temperature range 350-700 K. The TAC on carbon monoxide contaminated surfaces was 0.66 at 387 K. Dissert. Abstr.

N70-22748 State Univ. of New York at Buffalo.
CHEMICAL ANNEALING REACTIONS IN METAL CARBONYLS
Florian Witold Zielinski (Ph.D. Thesis) 1969 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-20522

The kinetics of the reconstruction of the target molecule from the fragments generated by thermal neutron activation of chromium hexacarbonyl and molybdenum hexacarbonyl was determined as a function of dose absorbed during activation, post-irradiation thermal treatment (26 C to 150 C), pre- and post-electron irradiation, and post-irradiation exposure to atmospheres of carbon monoxide and nitrogen. A mechanism consistent with the data assumes that the neutron activation produces a carbon monoxide deficient, Mo-99 or Cr-51 containing, fragment and free carbon monoxide groups which are localized nearby. During an annealing treatment these latter groups either diffuse to the recoil site and participate in the reconstruction or they may diffuse away. Reconstruction may be influenced also by long range diffusion of radiolytic carbon monoxide as well as carbon monoxide from the external atmosphere. Dissert. Abstr.

N70-22758 Pennsylvania Univ., Philadelphia.
EXCIMERS AND MIXED-EXCIMERS IN MOLECULAR CRYSTALS
Angelos Malliaris (Ph.D. Thesis) 1969 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-21400

The experimental evidence for the formation of mixed excimers (dimer formed from one excited and one unexcited molecule) in molecular crystals is presented. The case of pyrene-perylene mixed excimers were studied in a good detail including variety of temperatures. A less complete study of pyrene-crystal doped with 3:4 benzpyrene was made giving evidence for another mixed excimer formation. The mechanism of the excimer formation in concentrated solutions is described and an explanation is proposed for the excimer fluorescence from pure aromatic crystals (pyrene, perylene, etc.). The crystal fluorescence spectra of pyrene, perylene, 3:4 benzpyrene, 1:12 benzperylene, coronene and ovalene are shown at various temperatures and are explained in terms of the proposed model. The excimer formation in crystals is explained as the result of transitions form the excimer state zero point level to the vibrational levels of the ground state dimer inside the crystal. Dissert. Abstr.

N70-22759 Minnesota Univ., Minneapolis.
RECOMBINATION OF HYDROGEN AND OXYGEN IN THE PRESENCE OF INERT GASES UNDER THE INFLUENCE OF GAMMA RADIATION
Sofia Milner (Ph.D. Thesis) 1969 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-20081

The gamma radiation induced recombination of hydrogen and oxygen in the presence of inert gases was studied. Water was the reaction product. The experimental equipment used included a vacuum system, cesium-137 as the irradiation source, pyrex reactor of about 100 ml in volume, and gas chromatography for the analysis of the residual gases. Ethylene was used as the gas dosimeter. The inert gases used were helium, neon, argon, krypton and xenon. A kinetic mechanism was proposed and experimental data that corroborates the mechanism was obtained. The mechanism is a chain reaction mechanism inasmuch as the G values obtained were of the order of 100 to 1000 molecules/100 ev. The model proposed utilizes excited molecules as the initiation and considers the propagation and termination steps by free radicals. The reaction was found first order in hydrogen concentration, in oxygen concentration, and in dose rate. Dissert. Abstr.

N70-22774# Scientific Translation Service, Ann Arbor, Mich.
SPECTRA AND STRUCTURE OF THE PHOTOREDUCED FORMS OF PORPHYRINS IN AN ACID MEDIUM [SPEKTRY I STRUKTURA FOTOVOSSTANOVLENNYKH FORM PORFIRINOV V KISLOI SREDE]
A. N. Sidorov et al Oct. 1969 11 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 13, no. 6, 1968 p 993-997 Sponsored by AEC Prepared for ANL
(PB-187228T; ANL-Trans-779) Avail: CFSTI CSCL 07E

The existence of three types of photoreduced forms of porphyrine dications which are di-, tetra-, and hexahydroderivatives of initial porphirine dication is possible. Hydroderivatives of porphirine dication can be obtained both, by photochemical reduction in acid medium in the presence of reagent-restorer and by transfering neutral molecules of porphyrines photoreduced forms into the acid medium. Di- and tetrahydroderivatives of porphyrine dication have specific absorption bands about 450 and 500 milli microns correspondingly. Hexahydroderivatives have no bands in the visible region. The analogy of spectral characteristics of the reduced forms of porphyrine dication and of metall porphyrine is the evidence of the similarity of their molecular structures. Author (USGRDR)

N70-22789# Carnegie-Mellon Univ., Pittsburgh, Pa. Radiation Research Labs.
RADIATION RESEARCH LABORATORIES Quarterly Report, 1 Jul. - 30 Sep. 1969

15 Oct. 1969 16 p refs
(Contract AT(30-1)-2310)
(PB-187224; RRL-2310-281; Rept-6041; Q-49) Avail: CFSTI CSCL 07E

The scientific activities of the Radiation Research Laboratories which are reported here are supported, in part, by the U.S. Atomic Energy Commission. Abstracts are given of papers with the following titles: Calorimetric detection of transient intermediates in the formation of Meisenheimer complexes; An ESR study of the structural changes occurring with temperature in the CF2CONH2 radical; The kinetics of electron scavenging and ion recombination in the radiolysis of hydrocarbon solutions; Micellar catalysis in organic reactions; Kinetic and mechanistic implications; Theoretical considerations of ion recombination and scavenging in liquids; Electron scavenging in the gamma-radiolysis of diethyl ether. USGRDR

N70-22798 Vanderbilt Univ., Nashville, Tenn.
AN ELECTROCHEMICAL STUDY OF Yb(II) IN MOLTEN LiCl-KCl, PART 1. INVESTIGATION OF BIS (2-METHOXYETHYL) ETHER (DIGLYME) AS A SOLVENT FOR POLAROGRAPHIC STUDY OF ORGANIC COMPOUNDS, PART 2
Gale Jefferson Clark (Ph.D. Thesis) 1968 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-4627

Specific conditions were established for the production of a black material which was first observed as one of the products of the electrochemical reduction of Yb(III) at a platinum electrode in fused LiCl-KCl eutectic at 450 C. This material was found to appear only in conjunction with electrochemical reduction of Yb(III) solutions at a platinum electrode. The black material, thought earlier to be ytterbium metal, was analyzed semi-quantitatively and found to contain ytterbium and platinum in approximately two to one ratio. Controlled potential electrolysis of Yb(III) solution at a pyrolytic graphite electrode produced almost total conversion to Yb(II) which was found to be stable in the fused salt. None of the above black material was produced. Platinum metal would not react with the Yb(II) solution. Experiments with pure ytterbium metal showed it to be readily oxidized in the fused salt producing both Yb(II) and Yb(III). Bis(2-methoxyethyl) ether was examined as a solvent for the polarographic study of organic compounds. The main advantages of this solvent are its large negative polarization range, its ease of purification, and its strong ability to dissolve organic species. A summary of the polarographic data obtained in these studies is given. All polarographic waves were irreversible. Dissert. Abstr.

N70-22799# Mound Lab., Miamisburg, Ohio.
MOUND LABORATORY CHEMISTRY AND PHYSICS Progress Report, Apr.–Jun. 1969
17 Nov. 1969 28 p refs
(Contract AT(33-1)GEN-53)
(MLM-1606) Avail: CFSTI

Pseudo-contact shifts in NMR were used to determine the structure of several uranium coordination compounds. Single crystals of LiH and LiD were prepared by high-temperature reaction of the elements. In Th-229 recovery processes, test extractions of the U-233 purification raffinate gave poor and quite variable results. Curie amounts of Po were separated from trace levels of impurities by anion exchange and spontaneous deposition. The gamma spectrum of Sb-124 in the range 4.5 to 60 keV was measured with a lithium-drifted silicon detector. Above 60 keV it was measured with a lithium-drifted germanium detector. NSA

N70-22804 Ohio State Univ., Columbus.
SELECTED REACTIONS OF BORON HETEROCYCLES: STRUCTURAL ANALOGS OF CYCLOPENTANE DERIVED FROM 1,2-ETHANEDIOL AND 1,2-ETHANEDITHIOL
Jerry Logan Crist (Ph.D. Thesis) 1968 171 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-4862

Several reactions of five-membered boron heterocycles derived from 1,2-ethanediol and 1,2-ethanedithiol (the borolanes) were investigated. From these ring systems, an extensive compilation of boron-11 nmr data resulted which can be correlated with arguments concerning the relative abilities of oxygen and sulfur to pi-bond with boron. The first series of reactions involved 1,2-ethanediol and 1,2-ethanedithiol in low temperature adduct formation with boron Lewis acids, viz., B2H6 and B(CH3)3. The adducts decompose at temperatures above −20 C yielding the products outlined in equations 1–4. Boron-11 nmr was used as an effectual means of monitoring the decomposition processes and in identifying the products formed. Dissert. Abstr.

N70-22820# California Univ., Livermore. Lawrence Radiation Lab.
THE HEAT OF SOLUTION OF HYDROGEN IN METALS [KINZOKU NO SUISO YOKAINETSU]
Saburo Yanagisawa and Akira Tsujioka 1969 14 p refs Transl. into ENGLISH from Nihon Kinzoku Gakkaishi, (Japan), v. 23, no. 2, 1959 p 128–132
(PB-187813T; UCRL-Trans-10384) Avail: CFSTI CSCL 11F

The heat of solution of hydrogen in alkali metals and alkali earth metals is proportional to the magnitude of the positive element of the metals, namely the ionization potential. On the other hand, the heat of solution of hydrogen in poor absorber metals is inversely proportional to the ionization potential. The above mentioned contrasting phenomena prove that hydrogen is dissolved in the two metal groups mentioned above in the phase of either H (−) or H (+). Author (USGRDR)

N70-22821 Clarkson Coll. of Technology, Potsdam, N.Y.
PORE STRUCTURE ANALYSIS BY NITROGEN ADSORPTION
Edward Endre Bodor (Ph.D. Thesis) 1969 245 p
Avail: Univ. Microfilms: HC $11.05/Microfilm $3.20 Order No. 69-21161

Two new approaches to pore structure analysis were studied. The first is called the "modelless" method, because the analysis starts without assuming a pore shape model. The volumes, surfaces and hydraulic radii obtained are properties of the cores of groups of pores. When capillary condensation takes place in a pore, the pore walls have already an adsorbed film on them; the core is defined as the empty space in the pore. For many purposes pore systems can be adequately characterized by the structure of the cores, but if pore parameters are needed, a model has to be assumed for the pore shape. Since the new method gives correct values for all three parameters of the cores, the pore parameters derived from the core parameters will be nearly correct. The second new approach is a method for the determination of the pore volume and surface distributions of micropores. The combination of the micropore analysis method and the modelless method makes a complete pore structure analysis possible. Dissert. Abstr.

N70-22822 Stevens Inst. of Tech., Hoboken, N.J.
AN INVESTIGATION OF AQUEOUS ELECTROLYTE SOLUTIONS BY PROTON MAGNETIC RESONANCE
Paul Swenson Knapp (Ph.D. Thesis) 1969 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-21293

The measurement and interpretation of the proton chemical shifts of aqueous electrolyte solutions as a function of temperature at various electrolyte concentrations, were investigated. The proton chemical shifts of aqueous solutions of NaCl, NaClO4, LiCl, LiBr, KF, CaCl2, Al(NO3)3, and HCl were measured relative to gaseous ethane at five temperatures and a number of electrolyte concentrations. The proton chemical shifts of aqueous HClO4 solutions are also discussed. The observed chemical shifts were corrected for volume magnetic susceptibility differences. The

correction terms were determined from nuclear magnetic resonance by the nonspinning tube technique found to be linear for each electrolyte studied. The corrected shift-versus-temperature lines at various concentrations up to 5 or 6 molal yielded a surprising result: for a given electrolyte all the lines, including the line for pure water, intersect at a common point. Dissert. Abstr.

N70-22829 Arizona State Univ., Tempe.
INERT CARRIER-GAS FUSION DETERMINATION OF TOTAL NITROGEN ABUNDANCES IN STONY AND IRON METEORITES
Everett Kay Gibson, Jr. (Ph.D. Thesis) 1969 213 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 69-20765

Total nitrogen abundances were measured in 123 iron meteorites and 114 stony meteorites. The meteorites studied comprise a representative sampling of the different structural and chemical classes of both the stony and iron meteorites. Both stony and iron meteorites which exhibit weathering effects are enriched (contaminated) in their nitrogen abundances. The iron-nickel system of the iron meteorites is not saturated with respect to nitrogen or the nitrogen has diffused to some other location. Troilite inclusions of the iron meteorites are enriched in their nitrogen contents as compared to the surrounding metal phases. Certain structural groups of the iron meteorites have similar nitrogen abundances. Nitrogen contents of the iron meteorites and their microhardness appear to be positively correlated. Nitrogen contents of the meteorites are inversely related to the cooling rates of the meteorites. Dissert. Abstr.

N70-22832# Chemical Inspectorate, London (England).
A MICRO METHOD OF DETERMINING THE WATER CONTENT OF NYLON
H. L. Evans Feb. 1968 10 p refs
(CI-MEMO-221) Avail: CFSTI

A method of determining the water content of small samples of nylon weighing between 10 mgm and 100 mgm is described. The method applies to the examination of samples which are finely divided, as well as to single fragments, such as shavings or chippings, which have been pared or cut from a large specimen in the form of a moulded article. It can thus be applied to the study of the degree of moisture penetration throughout a piece of fabricated material. Author (ESRO)

N70-22841 IIT Research Inst., Chicago, Ill.
MODEL SYSTEM ISOTOPE EFFECT STUDIES INVOLVING THE HYDRONIUM ION
Gerald Walter Koeppl (Ph.D. Thesis) 1969 321 p
Avail: Univ. Microfilms: HC $14.65/Microfilm $4.15 Order No. 69-21933

Kinetic protium-deuterium isotope effects were calculated within the framework of Eyring's absolute reaction rate theory on the basis of a non linear five-center model for hydrogen ion transfer from the hydronium ion. The model system was defined in terms of empirical relationships involving valence bond lengths, angles, force constants, and Pauling's "bond order." The results indicated that primary and secondary effects in this system were related to transition state symmetry in a different manner. The valence bond force constant sets adopted for the reactant hydronium ion and product water, in the model study, were chosen to generate vibrational frequencies for H3O(+), D3O(+), H2O and D2O which were in reasonable agreement with values appropriate for the liquid state. The model force constant sets and Swain and Bader's librational frequencies for the hydronium ion and water were employed to evaluate the equilibrium constant L. A value in reasonable agreement with experimental results was obtained. Dissert. Abstr.

N70-22843 IIT Research Inst., Chicago, Ill.
PARAMAGNETIC RESONANCE STUDIES ON TRANSITION METAL HEXAMMINE COMPLEXES
Chin-I Shyr (Ph.D. Thesis) 1969 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-21937

The electron spin resonance technique was employed to study the magnetic properties of Mn(NH3)6(++), Co(NH3)6(++), Ni(NH3)6(++), and Cu(NH3)6(++). These ions were diluted in the diamagnetic zinc and cadmium hexammines. The evidence supports the conclusion that at temperatures above a characteristic transition temperature the crystal field in the hexammines is perfectly octahedral. A general result is that the metal-NH3 bond is less ionic than the metal-H6O bond, but more ionic than other metal-nitrogen bonds. The cupric hexammine ion has exhibited the Jahn-Teller effect. The coexistence range of both anisotropic and isotropic spectra is from approximately 77 K to room temperature. The spin-Hamiltonian parameters of the anisotropic spectrum were used to calculate the bonding parameters. The quenching of ammonia rotation was detected from the sudden transition of the isotropic Ni(NH3)6(++) line to three anisotropic lines. The anisotropic spectrum which has not been found previously was very clear and the non-octahedral part of the spin-Hamiltonian was determined. Dissert. Abstr.

N70-22847 Arizona State Univ., Tempe.
A STUDY OF SPECTRAL BAND SHAPES AND ABSORPTION COEFFICIENTS FOR ELECTRONIC TRANSITIONS, PART 1. AN INVESTIGATION OF PARAMAGNETIC QUENCHING OF PHOSPHORESCENCE BY TRANSITION METAL IONS
Clifford Otis Hill (Ph.D. Thesis) 1969 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-20773

In part 1, it is shown that with the introduction of three parameters, in order to circumvent the problems associated with the determination of the normal coordinates and frequencies, a much simplified semi-empirical expression for the absorption coefficient results, with which experimental spectra may be calculated quite accurately. The physical significance of these parameters, and a method by which they may be evaluated experimentally is discussed. In order to test this theory and demonstrate its application, the absorption spectra for acetone and cis-stilbene are calculated, and is compared to the corresponding experimental spectra. The calculation of oscillator strengths and mean radiative lifetimes, using this theory, is also discussed. The quenching of phosphorescence by paramagnetic ions is investigated both experimentally and theoretically in part 2. Several external perturbations which could possibly give rise to this phenomenon are discussed and reasons are given for our selecting electron exchange interaction as the most reasonable choice. Dissert. Abstr.

N70-22848 Washington Univ., Seattle.
FUNDAMENTAL PROCESSES IN COMPETITIVE UNIMOLECULAR REACTION SYSTEMS
Carl William Larson (Ph.D. Thesis) 1969 332 p
Avail: Univ. Microfilms: HC $15.10/Microfilm $4.25 Order No. 69-20246

The competitive unimolecular decomposition reactions of some seventeen highly vibrationally excited alkyl radicals were studied in nonequilibrium systems. The excited radicals were produced by chemical activation wherein hydrogen atom addition to an olefinic double bond at room temperature was used. Olefins were designed such that the formed radicals could decompose competitively by as many as four non-equivalent C-C rupture pathways; the products of this C-C rupture are always a radical and stable olefin. A total of approximately 50 to 60 unimolecular reaction pathways were studied in 17 different chemically activated alkyl radicals. The results were interpreted and correlated with use of a quantum statistical model for the absolute unimolecular reaction rates. A prescription for estimating the vibration frequency assignments of activated complexes and alkyl radicals was

formulated. This prescription was applied according to strict rules to the approximately 50 to 60 decomposition complexes and to the 17 alkyl radicals studied. Dissert. Abstr.

N70-22864*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GUIDANCE AND CONTROL RESEARCH
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 151-155 refs (See N70-22851 10-34)
CSCL 07D

The behavior of a bulk-oxygen contaminated emitter is explained quantitatively. Diffusion of oxygen in tantalum provides an oxygen additive to the emitter surface which, when coadsorbed with cesium, gives enhanced emission. Low voltage cesium-ion sputtering is effective in removing oxygen to a depth much greater than several atomic spacings. Author

N70-22869*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POLYMER RESEARCH
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 191-204 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 07C

The effects of a simulated Venus atmosphere on polymeric materials were evaluated. Three commercially available materials of known heat resistance were exposed to air, nitrogen, and carbondioxide in a pressure chamber and subsequently tested for their mechanical properties. Results indicated that the carbon dioxide atmosphere reduced mechanical properties of the tested materials more than air or nitrogen. Chemical stress-relaxation studies on peroxide-cured styrene-butadiene rubber showed that for the first 100 hrs or so, stress relaxation at 27 degree C was attributable to viscoelasticity. Experiments in a dry nitrogen atmosphere found that, regardless of the temperatures used, decay in tensile force was less than 5% after 85 to 90 hrs. Since there was also no change in physical properties it was concluded that relaxation due to chemical changes is caused by atmospheric oxygen rather than by thermal effects. Also reported are fundamental chemical and physical properties of sterilizable battery separator membranes prepared by grafting poly(acrylic acid) onto thin films of polyethylene and then converting the acrylic acid to the potassium salt. G.G.

N70-22878 Massachusetts Univ., Amherst.
THE PHYSICAL PROPERTIES OF POLYURETHANES AND IONOMERS
Tisato Kajiyama (Ph.D. Thesis) 1969 177 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-19356

A study has been made of the relaxation phenomena in three series of hard polyurethanes in the temperature range from −190 to 200 C and at various frequencies up to 110 Hz using dynamic mechanical and dielectric relaxation. In order to elucidate the relationships between physical properties and the chemical structures of polyurethanes, some examples of hard polyurethanes were chosen for investigation. The samples were prepared by direct polymerization of three different diisocyanates (1,6 hexamethylene diisocyanate, methylene bis (4-phenyl isocyanate) and 4 methyl metaphenylene diisocyanates) and various diols which ranged from 1,2-ethanediol to 1,10-decanediol (H-, DP- and 4M-series, respectively). This procedure resulted in samples with regular variation in chemical structure and physical properties. Dissert. Abstr.

N70-22881 Colorado Univ., Denver.
A STUDY OF RADIATIONLESS TRANSITIONS IN BENZENE AND NAPHTHALENE
Richard James Watts (Ph.D. Thesis) 1969 158 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-19579

Several of the radiationless transitions which occur in benzene and naphthalene were studied. The concept of a radiationless transition is introduced on the phenomenological basis provided by spectroscopic measurements. The theoretical descriptions of radiationless transitions which have been proposed prior to this study are discussed. A study of the fluorescence spectrum of naphthalene vapor upon excitation of the second excited singlet state is presented. Although no collisions occur during the lifetime of the second excited state, fluorescence is observed to originate in the first excited state, indicating that internal conversion is an intramolecular process in this case. The intensity of fluorescence from the second excited state is established to be not more than 0.002 of that from the first state. The stationary state and non-stationary state descriptions of an intramolecular radiationless transition are considered, and both are found to be capable of interpreting the internal conversion which occurs in naphthalene vapor. Dissert. Abstr.

N70-22931 California Univ., San Diego.
THE DISTRIBUTION OF INORGANIC CARBON IN THE EASTERN TROPICAL PACIFIC OCEAN
Chi Shing Wong (Ph.D. Thesis) 1968 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-8134

A new vacuum extraction method for the quantitative determination of total carbon dioxide in sea water or in low concentration carbonate solutions by infrared analysis is described. Shipboard extractions and preserved samples, later extracted in the shore laboratory, show that ocean water sterilized with 100 ppm. of mercuric chloride does not change its total carbon dioxide on storage in stoppered Pyrex bottles for a period of up to 3 months at room temperature. Data on total carbon dioxide collected on EASTROPAC expeditions in August-September, 1967 and in February-April 1968 in the eastern tropical Pacific Ocean from 20 N to 20 S suggest that the distribution of total carbon dioxide in the surface waters is mainly controlled by the surface current system. Calculations of the theoretical total carbon dioxide of the currents formed from the Countercurrent based on Wyrtki's equatorial circulation model agree with observed values. Dissert. Abstr.

N70-22932 Brandeis Univ., Waltham, Mass.
ULTRASONIC ATTENUATION IN CHEMICALLY REACTING SYSTEMS
Robert Scott Brundage (Ph.D. Thesis) 1969 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-20718

A simple cell for measuring the ultrasonic attenuation of a relatively small, 80 ml., liquid sample is described. The basic design is an optical bench arrangement which remains in perfect alignment throughout the experiment, with easily changed transducers of different fundamental frequencies. A detailed analysis of the electronic components of the pulse technique which functioned from 7 to 220 MHz. and of the acoustical wave path is included. The acoustical wave analysis relates the dependence of acoustic attenuation to the dynamic equilibria of chemical species having appropriate volume and enthalpy changes. The general equations are converted to the more useful molar quantities. Three methods of analyzing the experimental data are also derived and applied to pure water, aqueous ammonia, triethylamine, and copper (II)-adenosine triphosphate. Dissert. Abstr.

N70-22945 Polytechnic Inst. of Brooklyn, N.Y.
REVERSIBLE OXYGEN CARRIERS AS POLYMERIZATION INITIATORS
Nan-Ioh Yang (Ph.D. Thesis) 1969 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-20381

The use of reversible oxygen carriers in polymer chemistry is exploited. The reversible oxygen carrier systems proved to be unique thermal initiators for the polymerization of vinyl monomers. They incorporated the inhibiting oxygen molecules in the polymerization system as a part of a new initiator and resulted in a thermal polymerization system with no induction period. The

polymer obtained in such systems contained active end groups and can be used to produce block copolymers. Using the oxygen carriers, it was shown that a trace amount of oxygen was necessary in the initiating step of Oster dye-sensitized photopolymerization system. A study of chelating agents in Co(II)oxygen carriers showed that they functioned as electron donor for the photoreduction of methylene blue. Simply introducing a small amount of Co(II) ion into the conventional Oster dye-sensitized photopolymerization system provided an unique system wherein polymerization proceeded without an induction period. Dissert. Abstr.

N70-22947# Oregon State Univ., Corvallis.
RADIATION CHEMISTRY OF THE AQUEOUS NITRATE SYSTEM. PART 3: PULSE ELECTRON RADIOLYSIS OF CONCENTRATED NANO3 SOLUTIONS
Malcolm Daniels [1969] 42 p refs Sponsored by AEC
(RLO-2014-6) Avail: CFSTI

Optical absorption spectra and reaction kinetics of transient species in concentrated sodium nitrate and nitric acid solutions were investigated for 0.5 to 6.0M NaNO3 and 60.06 to 9M HNO3.NO3 was identified as a transient in concentrated neutral nitrate solutions and is shown to be characteristic of the direct effect. Yield of NO3 was constant from pH 4 to 11; it decays by 1st order kinetics strongly dependent on pH. In neutral solution NO2 is identified; it decays by 2nd order kinetics with (2k/E) = 140,000. NO2 is also produced by the direct effect, and as the yield of NO3 is intensity-dependent, a mechanism of formation is probably O + NO2 yields NO3. In acid solutions, NO3 is also formed by an indirect effect with a rate constant 1st order in NO3 and H(+). Author (NSA)

N70-22954 Carnegie-Mellon Univ., Pittsburgh, Pa.
PREDICTION OF POLYMER MELT PROCESSING BEHAVIOR
David Murry Best (Ph.D. Thesis) 1969 316 p
Avail: Univ. Microfilms: HC $14.40/Microfilm $4.05 Order No. 69-19087

The rheological behaviors of a commercial high density polyethylene and a low molecular weight polyisobutylene were investigated at 300-500 F for the purpose of predicting polymer melt processing behavior. Presented are an apparently general semitheoretical correlation between (recovery) shear modulus and applied stress, a modified method for obtaining and corrections from the Bagley plot, a model for predicting swell for long capillaries, and a correlation between swell and the inverse of the area-average Weissenberg Number. Swell and extrudate distortion, or melt fracture, as well as comparison of the sell data to various models and correlations of previous investigators, a note on friction factors for polymer melt flow, an illustration of normal stresses obtained from creep recovery data, and non-general, but still informative correlations between swell and wall Weissenberg Number, entrance pressure drop, and various individual viscometric functions and capillary dimensions are reviewed. Dissert. Abstr.

N70-22955 Polytechnic Inst. of Brooklyn, N.Y.
INTERACTIONS OF CELLULOSE WITH ORGANIC LIQUIDS AND VAPORS
Edward Armando Colombo (Ph.D. Thesis) 1969 164 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-20324

The nature of the interactions between cotton cellulose (73% crystalline by X-ray methods) and three organic molecules (benzene, methanol and N,N'-dimethylformamide (DMF) has been investigated by measuring the vapor adsorption isotherms of the three molecules as a function of temperature and pressure. The heat of adsorption of each vapor on the cellulose was determined from the temperature dependence of the vapor adsorption isotherms. The heats of adsorption were found to vary with coverage. The heats of adsorption at 0% coverage were obtained by extrapolation. The values were found to be: benzene (12 Kcal/mole), methanol (17 Kcal/mole) and DMF (23 Kcal/mole). The heats of adsorption obtained in this manner were compared with heats of hydrogen bond formation in low molecular weight model systems (2-ethoxyethanol + 2-ethoxyethanol and 2-ethoxyethanol + DMF). Dissert. Abstr.

N70-22966# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Chemistry and Materials Div.
CHEMISTRY AND MATERIALS DIVISION Progress Report. 1 Oct. -31 Dec. 1969
31 Dec. 1969 113 p refs
(AECL-3521; PR-CMa-11) Avail: CFSTI

Research centered on mass spectrometry, atomic absorption spectrometry, nuclear technicues and the automation of these methods, since not all areas of modern analytical science can be covered with the modest effort available. In the past year some of the advances made in these fields have been used in the heavy water and reactor fuels programs in AECL and elsewhere in the Canadian nuclear industry. These are described in more detail. Author

N70-22968 Temple Univ., Philadelphia, Pa.
OPTICAL ABSORPTION IN THE MIXED CRYSTAL SYSTEM ZIRCONIUM DIOXIDE-HAFNIUM DIOXIDE AND NIOBIUM PENTOXIDE-TANTALUM PENTOXIDE
Joseph George Bendoraitis (Ph.D. Thesis) 1968 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-18372

Studies were conducted to determine the effects of mixed crystal formation on the optical energy gap of oxides exhibiting closed-shell electronic configurations and very similar cationic ratii. Homogeneous monoclinic ZrO2 – HfO2 solid solutions were prepared by the thermal decomposition of the mixed zirconium and hafnium mandelato complexes, while orthorhombic Nb2O5 – Ta2O5 solid solutions were obtained by the ignition of the hydrous oxides resulting from the basic hydrolysis of the mixed metal ethoxides. X-ray analysis did not reveal the presence of ordered phases in either system; however, the presence of small amounts of the alpha-Nb2O5 phase was detected at compositions above 0.75 mole fraction Nb2O5. The lattice parameters varied linearly with composition in the ZrO2 – HfO2 system, but varied non-linearly in the Nb2O5 – Ta2O5 system. Dissert. Abstr.

N70-22975# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHANGES IN INFRARED SPECTRA DURING IONIZATION AGING OF POLYMER FILMS
S. N. Koikov et al 13 Aug. 1969 14 p refs Transl. into ENGLISH from the Russian Report
(AD-698524; FTD-HT-23-16-69) Avail: CFSTI CSCL 7/5

Polyethylene (I), polystyrene (II) and poly(ethylene terephthalate) (III) films were exposed to ionization discharges for 15-100 hours at room temperature in air or under oxygen. Ir spectra of treated and untreated samples were compared. The most apparent changes were observed in I, the spectra of III did not change, and the spectra of II showed small changes. The changes in spectra were accompanied by a decrease in resolution and an increase in background. The relative changes of I, II, and III films caused by ionization correspond to changes due to thermal oxidation and to irradiation in air. The changes in spectra agree well with the rate of oxygen absorption in the polymer films. The results show that I has a tendency toward oxidation and crosslinking, but is stable to ionization aging. III is very easily aged by ionization, but is not oxidized and crosslinked by ionization. The properties of II are intermediate between those of I and III. Author (TAB)

N70-22976# Oak Ridge National Lab., Tenn.
DEPENDENCE OF THE INTRINSIC MOBILITIES OF 6L AND 7L IN MOLTEN LC AND LNO3 ON THE TEMPERATURE AND CONCENTRATION
J. Jordan, R. Lenke, and A. Klemm 1968 12 p refs Transl. into ENGLISH from Z. Naturforsch., (Tuebingen) v. 23a, 1968

p 1563 – 1568
(PB-187230T; ORNL-TR-2222) Avail: CFSTI CSCL 07D

The quotient of the specific electrical conductivity of molten 6LiCl and 7LiCl as well as 6LiNO3 and 7LiNO3 was measured. In conduction experiments the ratio of the intrinsic mobilities of 6Li and 7Li was determined in molten LiCl, the results are interpreted by cooperative ion mobilities. Author (USGRDR)

N70-23015# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OIL ADDITIVES: SELECTED ARTICLES
A. Kuliev et al 17 Dec. 1968 100 p refs Transl. into ENGLISH from Tr. Vses. Soveshch. Po Khim. i Primeninyu Prisadok K Maslam i Toplivam, 2d (Moscow), 1966 74 p
(AD-695901; FTD-HT-23-283-68) Avail: CFSTI CSCL 11/8

Contents: Antioxidants for motor oils; Additives prepared from phosphonitrilic chloride; Higher esters of methacrylic acid for making ashless additives; Salts of alkylsalicylic acids; Dialkylphenyldithiophosphates; High-alkali alkylphenol additive; Separation of mechanical impurities; Chlorinated organophosphorus compounds with a metallic frictional surface; and The effect of polymer additives in an oil solution. TAB

N70-23018 IIT Research Inst., Chicago, Ill.
EFFECT OF ANIONIC CONSTITUENTS ON THE SURFACE IONIZATION OF LITHIUM SALTS
Eric Niels Sloth (Ph.D. Thesis) 1969 248 p
Avail: Univ. Microfilms: HC $11.25/Microfilm $3.20 Order No. 69-21938

A combination of high vacuum, flash desorption, and mass spectrometric techniques was applied to the study of the surface ionization of gaseous lithium atoms and lithium salt molecules incident on hot polycrystalline rhenium filament surfaces. Flash desorption of adsorbed gases prior to current measurements insured an atomically clean surface. Atomic and molecular beams of neutral particles were produced by Langmuir vaporization of lithium and lithium salts from a second rhenium filament. The validity of the Saha-Langmuir theory of surface ionization was demonstrated for the lithium-rhenium system over a temperature range of 1200 – 2600 K. Below 1200 K the lithium surface ionization current was less than expected due to lithium adsorption on rhenium, lowering the work function. The effective surface ionization work function was obtained for lithium on rhenium and the effective thermionic emission work function was measured. The difference between these work function values afford a measure of the degree of contrast of the emitter surface. Dissert. Abstr.

N70-23089 Polytechnic Inst. of Brooklyn, N.Y.
STUDIES ON OPTICALLY ACTIVE POLYMERS. PART 1: THE OPTICALLY ACTIVE CONDENSATION POLYMER POLY(ETHYLENE-1,2-CYCLOHEXANEDICARBOXYLATE). PART 2: OPTICALLY ACTIVE ADDITION POLYMERS POLYALPHA-OLEFINS WITH ZIEGLER-NATTA TYPE CATALYSTS
Toshiyuki Furuyama (Ph.D. Thesis) 1969 267 p
Avail: Univ. Microfilms: HC $12.15/Microfilm $3.45 Order No. 69-20332

Optically active, crystalline (X-ray) poly(ethylene (+) trans 1,2 cyclohexanedicarboxylate) has been synthesized by the acid chloride method and the conformational structure of the polyester was studied in solution by optical rotatory dispersion (ORD), circular dichroism (CD), ultraviolet (UV) and nuclear magnetic resonance (nmr) spectroscopy. The results did not indicate long well organized structures. The nature of stereoselectivity of stereospecific polymerizations were investigated. The syntheses of alpha-olefins and the catalyst activity of the monomers were discussed. The copolymer m.p. 203-208 C, synthesized from (+) (S)-3-methyl-1-pentene and %R) (S)-4-methyl-1-hexene (1:2.9 in molar ratio in the monomer feed) also exhibited a highly crystalline X-ray pattern (a 7/2 helix). It was concluded that the stereoselectivity was not destroyed by copolymerization, and that the stereoselectivity would be obtained even with an optically inactive catalyst system, if one of the co-monomers was optically active. Dissert. Abstr.

N70-23090 Mississippi Southern Coll., Hattiesburg.
A THERMOCHEMICAL STUDY OF THE C=N BOND ENERGY IN 2,2,5,5-TETRAMETHYL-2,5-DIHYDROPYRAZINE
Rose Gayle West (Ph.D. Thesis) 1969 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-20161

The lack of an accurately determined C=N bond energy for use in the calculation of the resonance energies of aromatic nitrogen heterocyclic systems has led to large discrepancies in the reported resonance energies of these compounds. Two compounds —2,2,5,5-tetramethyl-2,5-dihydropyrazine (I) and 2,2,5,5-tetramethylpiperazine (II)—were found to be thermally stable. These were examined with regard to determine a C = N bond energy which could be used in the calculation of resonance energies of aromatic nitrogen heterocyclic compounds. The heats of formation and atomization of (I) and (II) were determined via their heats of combustion and heats of sublimation. Heats of combustion were determined in an oxygen bomb calorimeter, and the heats of sublimation were calculated from vapor pressure curves obtained by the Knudsen method. The C=N bond energy, 130.3 kilocalories, was calculated from the difference in the heats of atomization of (I) and (II) and from other currently accepted bond energy values. Dissert. Abstr.

N70-23154 National Lending Library for Science and Technology, Boston Spa (England).
STUDIES OF BATH COMPOSITION FOR ELECTROPLATING Au-Cu AND Au-Cu-Cd ALLOYS
S. Kawai et al Dec. 1969 14 p refs Transl. into ENGLISH from Kinzoku Hyomen Gijutsu (Tokyo), v. 19, no. 9, 1968 p 6 – 11
(NLL-RTS-5350) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

It was found that a three-constituent Au-Cu-Cd plating system possesses a rose gold shade and has excellent corosion-resistant and wear-resistant properties, as well as having possibilities for practical use as a gold alloy plating suitable for thick plating. Factors such as plating bath composition and plating conditions were shown to have effects on the composition of precipitation layers in Au-Cd alloys. Author

N70-23157# Joint Publications Research Service, Washington, D.C.
ANOMALOUS WATER: DISCOVERY OR ERROR
V. Zhvirblis 6 Mar. 1970 8 p refs Transl. into ENGLISH from Khimiya i Zhizn, (Moscow), no. 12, 1969 p 37 – 44
(JPRS-50006) Avail: CFSTI

A brief analysis of Deryagin's report of anomalous or modified water is presented. Included are questions and comments by academecians. F.O.S.

N70-23192 National Lending Library for Science and Technology, Boston Spa (England).
ELECTROLYSIS OF AN AQUEOUS SOLUTION OF SODIUM SULPHATE WITH OXYGEN DEPOLARISATION AT SIMPLE NICKEL/CARBON CATHODES [ELEKTROLIZ VODNOGO RASTVORA SUL'FATA NATRIYA S KISLORODNOI DEPOLYARIZATSIEI NA PROSTYKH NIKELEVOUGOL'NYKH KATODAKH]
A. K. Gorbachev et al Dec. 1969 8 p refs Transl. into ENGLISH from Khim. Prom. (Ukraine), v. 3, 1969 p 11 – 13
(NLL-RTS-5529) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d or 1 NLL photocopy coupon

The depolarizing effect of oxygen and air on the reduction of cathode potential in the electrolysis of sodium sulphate at porous nickel/carbon electrodes was investigated and found to be

effective at industrial current densities. This electrolysis method reduces the voltage at the electrolyzer by 1.1 V on depolarization with oxygen and 0.9 V using air. The reduction in electrical energy consumption is 800 and 650 kWh per ton NaOH, respectively. E.M.C.

N70-23201*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SHOCK TUBE MEASUREMENTS OF SPECIFIC REACTION RATES IN THE BRANCHED CHAIN H2-CO-O2 SYSTEM

T. A. Brabbs, F. E. Belles, and R. S. Brokaw [1969] 22 p refs

(NASA-TM-X-52758) Avail: CFSTI CSCL 07D

Rate constants of four elementary bimolecular reactions were determined by monitoring the exponential growth of CO flame band emission behind incident shocks in four suitably chosen gas mixtures. Less directly, by analysis of early, linear luminosity and times to 50% of peak light intensity, the rate of the initiation reaction, CO + O2 → CO2 + H is estimated to be k sub 6 = 1.6 × 10 to the 13th power exp(−41 kcal/RT). Author

N70-23202*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL VERIFICATION OF EFFECTS OF TURBULENT BOUNDARY LAYERS ON CHEMICAL-KINETIC MEASUREMENTS IN A SHOCK TUBE

F. E. Belles and T. A. Brabbs [1970] 24 p refs Proposed for presentation at 13th Intern. Symp. on Combust., Salt Lake City, 23–29 Aug. 1970; sponsored by The Combust. Inst.

(NASA-TM-X-52761) Avail: CFSTI CSCL 07D

Experiments were conducted to demonstrate the existence and magnitude of the effects of nonuniform shock tube flow on kinetic results. Atomic oxygen concentration was observed in a rich H2/O2/CO/Ar mixture behind incident shocks that produced turbulent boundary layers and essentially constant shock front temperatures, at eight initial pressures from 50 to 120 torr. The exponential time constant for growth of [O] and the time at which peak concentration occurs are governed by the rate constant for H + O2 → OH + O. Values of the rate constant were fit to the 120 torr data using two analyses: one incorporating the boundary layer effects on flow properties and residence time as formulated by Mirels; and the other making the conventional assumption of constant post shock conditions. Two sets of predictions were then made for the lower pressure runs and compared with experiment. The comparison showed that the conventional analysis is incorrect; that there is a large error in the rate constant derived from it; and that Mirels' formulas satisfactorily account for the observed results. Author

N70-23216# Royal Aircraft Establishment, Farnborough (England).

THE THERMAL STABILITY OF AROMATIC POLYIMIDES. PART 1: FACTORS AFFECTING THE STABILITY OF POLY N,N'(4,4'-DIPHENYLETHER) PYROMELLITIMIDE

R. A. Dine-Hart and W. W. Wright Jul. 1969 38 p refs

(RAE-TR-69158) Copyright. Avail: CFSTI

Polyimide samples in the form of powders, films and sintered mouldings were prepared from pyromellitic dianhydride and 4,4'-diaminodiphenylether. The effect of environmental variables on the oxidative stability at 400 C of the high molecular weight films was studied and it was found that hydrolytic processes could greatly accelerate the degradation. The higher stability of the powders was attributed to the presence of low molecular weight fractions, which inhibited these hydrolytic processes. Support for this postulate was the fact that it was possible to improve the stability of the films by adding low molecular weight materials during the casting process and it was possible to destabilise the powders by prolonged solvent extraction. Comparison of weight loss results on polypyromellitimides is therefore only meaningful when these were determined on high molecular weight films under controlled humidity conditions. Author (ESRO)

N70-23220 Houston Univ., Tex.

STABLE CARBON ISOTOPE RATIO MEASUREMENT OF METEORITIC CARBONACEOUS MATERIAL

Donald Andrew Flory (Ph.D. Thesis) 1969 162 p

Avail: Univ. Microfilms: I:C $7.60/Microfilm $3.00 Order No. 69-21752

A high precision isotope ratio measurement system was designed, constructed, and evaluated to determine its capabilities. The design objective was to construct a system capable of measuring carbon isotope ratio differences with a precision of + or − 0.005 percent. A detailed description sufficient to allow one to fabricate, assemble, and operate a complete isotope ratio measurement system is given. The system described here incorporates the most modern electronics available; and though it has no more apparent precision than previously reported instruments it is simpler to operate, less time consuming, and more reliable. A new sample combustion technique developed during this study which greatly simplifies both the equipment required and the operating procedures is also described. Dissert. Abstr.

N70-23258# Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France).

DETERMINATION OF CORRECTION COEFFICIENTS FOR QUANTITATIVE ANALYSIS BY MASS SPECTROMETRY: APPLICATION TO URANIUM IMPURITY ANALYSIS [RECHERCHE DES COEFFICIENTS DE CORRECTION PERMETTANT L'ANALYSE QUANTITATIVE PAR SPECTROMETRIE DE MASSE: APPLICATION A L'ANALYSE D'IMPURETES DANS L'URANIUM]

Jean-Pierre Billon Jan. 1970 60 p refs In FRENCH; ENGLISH summary

(CEA-R-3883) Avail: CFSTI

The basic principles of spark source mass spectrometry are recalled, and it is shown how the method can be used in quantitative analysis when attention is paid to some theoretical aspects. The relation between the sample analyzed and its ionic beam was assumed to be constant. The results were in fairly good agreement with a simple theory of ionization yield in spark sources, and theoretical relative sensitivity factors in a uranium matrix were developed. Author (ESRO)

N70-23288*# National Bureau of Standards, Washington, D.C. Inst. for Basic Standards.

THEORETICAL MEAN ACTIVITY COEFFICIENTS OF STRONG ELECTROLYTES IN AQUEOUS SOLUTIONS FROM 0 TO 100 C

Walter J. Hamer Dec. 1968 278 p refs

(NASA Order R-09-022-029)

(NASA-CR-109356; NSRDS-NBS-24) Avail: SOD $4.25; CFSTI CSCL 07D

In determining the activity coefficients of electrolytes in aqueous solutions from the freezing point to the boiling point of the solvent, various equations were used in the treatment of the data. Values for activity coefficients of electrolytes of various valence types from 0 to 100 C, and for ionic strengths from zero to 0.1 molal or 0.1 molar, as calculated by seven different equations based on the theory of interionic attraction are given. These equations are those of Debye and Hückel, Güntelberg, Davies, Scatchard, and Bjerrum, and what may be termed an extended Güntelberg equation and an extended Scatchard equation. Author

N70-23291*# California Inst. of Tech., Pasadena.

DISTRIBUTION OF CARBON ISOTOPES AND THEIR BIOCHEMICAL AND GEOCHEMICAL SIGNIFICANCE

Samuel Epstein *In* NASA. Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 5-14 refs *Its* Contrib. no. 15 (See N70-23290 10-04)

(Contract AT(04-3)-427; Grant NSF GB-7517)

Avail: SOD $2.75; CFSTI CSCL 07E

Discussed are carbon isotope fractionations associated with

biological processes and a model is formulated for carbon isotope fractionation during photosynthesis. It is shown that the first step constitutes carbon dioxide absorption into the cytoplasm accompanied by isotope fractionation through exchange between atmospheric carbon dioxide and dissolved carbon dioxide in the cytoplasma. The second carbon isotope fractionation step is the enzyme catalyzed fixation process that adds the dissolved carbon dioxide to ribulose-1,5-Diphosphate (RuDP) to form 3-phosphoglyceric acid (PGA). A suggested third step is the translocation of dissolved carbon dioxide by the flow of sap through the vascular system of the plant. Thus, the isotopically light carbon dioxide will be fixed photosynthetically because of isotope fractionation and the remaining carbon-13 enriched carbon dioxide in the cytoplasm is pumped away through the roots. G.G.

N70-23292*# Harvard Univ., Cambridge, Mass.
CARBON DIOXIDE, CARBONIC ACID, AND BICARBONATE ION: PHYSICAL PROPERTIES AND KINETICS OF INTERCONVERSION
John T. Edsall *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 15-34 refs (See N70-23290 10-04)
(Grants NSF GB-1255; NSF GB-5826; PHS-HE-03169)
Avail: SOD $2.75; CFSTI CSCL 07D

The structure and certain properties of carbon dioxide, carbonic acid, and the bicarbonate ion are reviewed. The topics discussed include the solubility of CO2 in water and in several other polar and nonpolar solvents and a comparison with other simple molecules, the thermodynamics of the hydration of CO2 and the ionization of H2CO3, the velocity of hydration of CO2 and the dehydration of bicarbonate ion or H2CO3, and the catalysis of the hydration and dehydration reactions by various inorganic and organic molecules and ions, including copper chelate complexes of peptides and related compounds. Certain unexplained discrepancies among the existing data are pointed out, with particular reference to the true ionization constant of H2CO3 and the rate constants for the hydration and dehydration reactions at various temperatures. Author

N70-23293*# Royal Danish School of Pharmacy, Copenhagen.
THE CARBAMATES OF GLYCYLGLYCINE AND GLYCYLGLYCYLGLYCINE KINETICS AND EQUILIBRIA
Mogens Ballund Jensen *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 37-40 refs (See N70-23290 10-04)
Avail: SOD $2.75; CFSTI CSCL 07C

The velocity constants for the reaction between carbon dioxide and the amino groups in glycylglycine and glycylglycylglycine have been determined; the equilibrium constants for the equilibria between carbamates and carbonates have been calculated. The velocities of decomposition of the carbamates in a basic medium have been investigated, and the experimental values of the velocity constants have been compared with the values calculated from a theoretical expression. Author

N70-23294*# Cambridge Univ. (England).
STUDIES ON THE PK AND RATE OF DISSOCIATION OF THE GLYCYLGLYCINE-CARBAMIC ACID MOLECULE
F. J. W. Roughton and L. Rossi-Bernardi (Milan Univ.) *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 41-45 refs (See N70-23290 10-04)
Avail: SOD $2.75; CFSTI CSCL 07C

Carbamate reaction kinetics of carbon dioxide with glycylglycine were measured for the velocity constant of the dissociation reaction RNHCOOH yields CO2 + RNH2; the ionization constant of the unstable carbamic acid RNHCOOH was estimated. Results indicated that the electrically neutral form is predominantly NH2COOH rather than NH3(+)COO(-). G.G.

N70-23295*# Yale Univ., New Haven, Conn.
CARBAMATE FORMATION AND BREAKDOWN: KINETICS AND MECHANISM
Michael Caplow *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 47-54 refs (See N70-23290 10-04)
(Grant NIH GM-11820)
Avail: SOD $2.75; CFSTI CSCL 07D

Carbamate formation and breakdown in enzyme-catalyzed radioactive carbon dioxide transfer reactions with alkaline amine solutions was assayed by barium quenching technique in which the carbamates were separated from carbonate by the differential solubility of their barium salts. The use of radioactive carbon dioxide eliminated the consumption of amine or hydroxide so that the reactions were of a pseudo-first order even at very low hydroxide and amine concentrations. Results obtained in an experimental reaction of hydrazine with carbon dioxide at pH 13.70 are presented. A decomposition scheme for carbamates shows that decarboxylation proceeds via acid-catalyzed and acid-uncatalyzed pathways, which corresponded, respectively, to the reverse of the uncatalyzed and hydroxide-catalyzed pathways observed in carbamate formation. Rate data established that the specific acid-catalyzed reaction predominated, event at very high pH, and the hydrogen ion dependence on the rate of the decarboxylation was clear. G.G.

N70-23296*# Pennsylvania Univ., Philadelphia.
RATE OF REACTION OF CO2 WITH HUMAN HEMOGLOBIN
Robert E. Forster *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 55-59 refs (See N70-23290 10-04)
Avail: SOD $2.75; CFSTI CSCL 07C

A continuous-flow rapid-reaction apparatus was used to measure the reaction rate of carbon dioxide with human hemoglobin to form carbamate under physiological conditions. Solutions of deoxygenated hemoglobin in water were mixed with a carbon dioxide solution in water and the changes in dissolved carbon dioxide were measured by carbon dioxide tension electrode. Carbon dioxide tension decrement at 0.1 seconds represented the formation of hemoglobin carbamate at pH values from 6.55 to 7.64; the amount of carbamate formed increased as the pH increased. Since it is assumed that there is one NH2 group available to form carbamate for each molecule of iron in the hemoglobin molecule from pH 7 to 8, this relationship provides an equation describing the fraction of the total amount of amine which has formed carbamate. G.G.

N70-23298*# Milan Univ. (Italy).
THE ESTIMATION OF HEMOGLOBIN-CO2 COMPOUNDS BY GEL FILTRATION AND ION-EXCHANGE CHROMATOGRAPHY
L. Rossi-Bernard, M. Pace, F. J. W. Roughton (Cambridge Univ.), and L. Van Kempen (Nijmegen Univ.) *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 65-71 refs (See N70-23290 10-04)
Avail: SOD $2.75; CFSTI CSCL 07C

Described is a combined gel filtration and ion-exchange procedure for the separation of hemoglobin-carbon dioxide from carbonic acid, HCO3(-), and CO3(2-). The hemoglobin solution is equilibrated with carbon dioxide and rapidly mixed with potassium hydroxide till a pH of about 12 is reached; thus, H2CO3 and HCO3(-) are completely transformed into CO3(2-). Since the HbCO2 is relatively stable under these conditions, it can be readily separated out by column elution procedure before an appreciable amount of carbamate has been decomposed. G.G.

N70-23299*# Cambridge Univ. (England).
SOME PROPERTIES OF HORSE HEMOGLOBIN SPECIFICALLY MODIFIED AT THE ALPHA-AMINO GROUPS
J. V. Kilmartin and L. Rossi-Bernardi (Milan Univ.) *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969

p 73–88 refs (See N70-23290 10-04)
Avail: SOD $2.75; CFSTI CSCL 07C

Horse hemoglobin was specifically modified at the alpha-amino groups by reaction with cyanate. These derivatives retained heme-heme interactions. When the alpha-amino group of the alpha-chain was chemically modified, the Bohr effect was reduced by 30 percent. When both alpha-amino groups of both chains were modified, there was no oxygen linked CO2 binding and probably no CO2 binding at all under physiological conditions, thus showing that the alpha-amino groups are responsible for the binding of CO2 by horse hemoglobin. Author

N70-23300*# Uppsala Univ. (Sweden). Wallenberg Lab.
X-RAY DIFFRACTION STUDIES ON THE STRUCTURE OF CARBONIC ANHYDRASE
A. Liljas, K. K. Kannan, P. C. Bergsten, K. Fridborg, L. Jaerup et al *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 89–99 refs (See N70-23900 10-04)
Avail: SOD $2.75; CFSTI CSCL 07C

A number of complexes with human carbonic anhydrase form C (HCAC) was studied using X-ray diffraction methods in projections. It was found that all anionic inhibitors (such as sulfonamides, iodide, Roussin's salt, and negatively charged heavy metal complexes) occupy almost the same position. This phenomenon explains the competition observed among some for the active site. It was also found that all these groups, except the iodide, were within binding distance of the zinc atom of the enzyme. The position in projections of two cationic inhibitors was shown to be, with some probability, in the vicinity of the zinc atom. Author

N70-23301*# Yale Univ., New Haven, Conn. Kline Chemistry Lab.
ON THE CATALYTIC MECHANISM OF CARBONIC ANHYDRASE
J. H. Wang *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 101–107 refs (See N70-23290 10-04)
(Grant PHS-GM-04483)
Avail: SOD $2.75; CFSTI CSCL 07C

Previous infrared data have shown that in the carbonic anhydrase-catalyzed hydration of carbon dioxide, it must be the OH(-) coordinated to the Zn(II) of the enzyme that attacks the bound CO2 and converts the latter to HCO3(-). A comparison of the calculated pseudo-first-order hydration rate constant for a hypothetical system, in which an OH(-) ion is placed in juxtaposition with a bound CO2 molecule shows that the enzyme must have additional means of expediting the reaction. A possible mechanism for activating the OH(-) of Zn(II) is proposed in which this OH(-) group is assumed to be hydrogen bounded to a strategically located basic imidazole group for facilitated proton transfer. The proposed mechanism is supported by infrared absorption, cyanide titration, and reaction rate data on the native enzyme, by optical data on the CO(II)-enzyme, as well as by the results of labeling experiments from several laboratories. Author

N70-23302*# Goteborg Univ. (Sweden).
PRIMARY STRUCTURE STUDIES ON HUMAN CARBONIC ANHYDRASE B AND ITS ACTIVE SITE
B. Anderson, P. O. Nyman, and L. Strid *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 109–114 refs (See N70-23290 10-04)
(Grants PHS-GM-12280-03; FG-Sw-107)
Avail: SOD $2.75; CFSTI CSCL 07C

The amino acid sequence of human erythrocyte carbonic anhydrase B has been investigated. The protein, which consists of a single polypeptide chain of approximately 260 amino acid residues, has been split with cyanogen bromide and by tryptic hydrolysis of arginyl peptide bonds after blocking of the lysine side chains by acetamidination. Fragments that together account for the complete sequence of the protein have been purified, and an arrangement of these fragments in order has been suggested. Sequence studies of the fragments have been carried out, and at present about one-third of the total sequence of the protein has been determined. In parallel, studies have been carried out with the enzyme chemically modified with active-site-directed reagents. Bromoacetate and N-chloracetylchlorothiazide have previously been shown to inactivate the enzyme with a concomitant formation of one equivalent of 3' derivatives of histidine. Studies of modified enzyme show that the two reagents react specifically with different histidines, which implies the presence of two histidine side chains in the active center region of human carbonic anhydrase B. Author

N70-23303*# Laboratoire de Chimie Biologique, Marseille (France).
INVESTIGATIONS OF THE STRUCTURE OF HUMAN AND BOVINE CARBONIC ANHYDRASES
G. Laurent and Y. Derrien *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 115–120 refs (See N70-23290 10-04)
Avail: SOD $2.75; CFSTI CSCL 07C

The N-terminal amino acid of human C(HCAC) and bovine B(BCAB) carbonic anhydrases was identified as N-acetyl-serine. An identical N-terminal hexapeptide, N-acetyl-Ala-Ser-Pro-Asp-Trp-Gly, has been isolated from the A and B human enzymes (HCAA and HCAB). Alkaline treatment of HCAB in suitable conditions is followed by important modifications of the ultraviolet spectrum and a splitting into multiple electrophoretically different components; the first of these to be formed is probably identical to HCAA. Similar results have been obtained with BCAB. Ultraviolet spectrum modifications are reversible, whereas the splitting into multiple conformers is not reversible by neutralization. Of the A and B forms of HCA and BCA, only the B form is probably physiologically significant. Author

N70-23304*# Harvard Univ., Cambridge, Mass.
PRIMARY STRUCTURE STUDIES ON HUMAN CARBONIC ANHYDRASE C
Louis E. Henderson (Chalmers Tech. Inst. and Goteborg Univ.) *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 121–129 refs (See N70-23290 10-04)
Avail: SOD $2.75; CFSTI CSCL 07C

Two approaches have been used to obtain information relating to the primary structure of human carbonic anhydrase C. Peptides have been isolated from a tryptic digest of the whole protein. This straightforward approach did not yield a complete set of tryptic peptides. The lysine epsilon-amino groups of the protein were blocked with maleic anhydride and the protein digested with trypsin. Five large peptide fragments were isolated. After removal of the blocking agent, the isolated fragments were redigested with trypsin. The tryptic peptides derived from some of these large fragments have been isolated. These peptides, together with the tryptic peptides obtained from the first approach, comprise a nearly complete set of tryptic peptides from human carbonic anhydrase C. The amino acid composition of the tryptic peptides is presented. The grouping of the tryptic peptides in the large fragments and a knowledge of the N- and C-terminal regions of the molecule permit the construction of an overall sketch of the amino acid sequence of human carbonic anhydrase C. Author

N70-23305*# Institute of General Biochemistry, Milan (Italy).
STUDIES ON CARBONIC ANHYDRASE FROM SPINACH LEAVES: ISOLATION AND PROPERTIES
Cristiano Rossi, Alberto Chersi (Inst. of Organic Chem.), and Marco Cortivo (Inst. of Organic Chem.) *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 131–140 refs (See N70-23290 10-04)
Avail: SOD $2.75; CFSTI CSCL 07C

Homogeneous carbonic anhydrase preparations from spinach

and bovines were evaluated for the properties of their isolated proteins. Considerable differences in kinetic data were noticed between the two enzymes. The plane enzyme possessed less catalytic versatility than the erythrocyte carbonic anhydrase. No activity was found for the hydrolysis of p-nitrophenylacetate. Plant enzyme molecular weight appears to be about five times that of the vertebrate enzyme; its amino acid composition shows some differences, especially in respect to the tryptophan residues. The plant enzyme does not contain any metals and SH groups appear to be an essential part of the active site. Author

N70-23306*# Yale Univ., New Haven, Conn.
CARBONIC ANHYDRASE: CONFORMATION OF THE ACTIVE CENTER AND THE MECHANISM OF ACTION
Joseph E. Coleman *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 141–156 refs (See N70-23290 10-04)
(Grant NIHAM-09070-04)
Avail: SOD $2.75; CFSTI CSCL 07C

Carbonic anhydrase combines with an optically inactive azosulfonamide to form a highly colored enzyme-inhibitor complex. Bathochromic-hypochromic shifts of the visible absorption bands indicate the presence of a hydrophobic binding site for the sulfonamide. Binding is metal ion dependent and the protein environment induces large ellipticity in the previously optically inactive bands. Circular dichroism spectra of azosulfonamide complexes of five isozyme and species variants of carbonic anhydrase reveal that both sign and magnitude of the multiple large visible ellipticity bands are unique for each isozyme. Cyanide can displace the azosulfonamide from its binding site. Difference titration data show that below the pK sub alpha values of H2S and HCN, binding of these inhibitors to Zn(II) and Co(II) carbonic anhydrase is accompanied by the release of H(+) ions. Over the pH range in which the inhibitors are in the form CN(-) and HS(-), binding is accompanied by the appearance of (-)OH ions. The data fit the theoretical curves constructed by assuming a single additional H(+) dissociation associated with the protein, coupled with the metal ion, and described by a pK sub alpha of 8.1. The latter coincides with the inflection point of the pH-rate profile for catalysis by human carbonic anhydrase B. A mechanism based on a mixed enzyme-zinc-hydroxide as the active form of the enzyme is proposed for the hydration of CO2 and the hydrolysis of p-nitrophenyl acetate. Author

N70-23307*# Goteborg Univ. (Sweden).
ON THE MECHANISM OF SULFONAMIDE INHIBITION OF CARBONIC ANHYDRASE
Sven Lindskog (Chalmers Inst. of Tech.) *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 157–177 refs (See N70-23290 10-04)
(Grants PHS-GM-12280-03; FG-Sw-107)
Avail: SOD $2.75; CFSTI CSCL 07C

The evidence for the essential role of the metal ion in sulfonamide binding is reviewed. The pH-dependence of the inhibition of bovine carbonic anhydrase by acetazolamide has been studied and is interpreted in terms of the pK of the activity-linked group in the enzyme and the microscopic ionization constants of the inhibitor. It is shown that the ionization state of the sulfonamide group is of critical importance for the binding rather than the overall charge of the inhibitor molecule. A comparison of the inhibition constants and the apparent recombination rate constants for two closely related sulfonamides—benzene sulfonamide and sulfanilamide—suggests that the anionic form of the inhibitor is bound to the enzyme. It presumably competes with OH(-) for the anion binding site, part of which is the metal ion. The inhibition constants for a large number of benzene sulfonamides with one additional ring substituent are discussed in terms of hydrophobic interactions between the inhibitors and the enzyme and suggest that the hydrophobic slot or surface on the enzyme is of considerable size. Apparent rate constants for the binding of various types of sulfonamides to bovine carbonic anhydrase are compatible with a direct combination of the ionized sulfonamide with the acidic form of the activity-linked group on the enzyme in an almost diffusion-controlled reaction, but may indicate a more complex mechanism. Preliminary results, indicating that acetazolamide does not compete with CO2 in human carbonic anhydrase B, are given. Author

N70-23308*# Purdue Univ., Lafayette, Ind.
THE SPECIES OF CO2 UTILIZED IN THE CARBOXYLATION OF P-ENOLPYRUVATE AND PYRUVATE
T. G. Cooper, T. T. Tchen, H. G. Wood, C. R. Benedict, and D. L. Filmer *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 183–193 refs (See N70-23290 10-04)
(Contract AT(30-1)-1320; Grants PHS-FR-06013-02; NSF GB-2766; NSF GB-2599)
Avail: SOD $2.75; CFSTI CSCL 07C

Previous studies with propionyl-CoA carboxylase and with P-enolpyruvate carboxylase using O-18 labeled bicarbonate have indicated that bicarbonate is the reactive species in these fixations of "CO2." We have investigated the species of "CO2" in reactions catalyzed by pyruvate carboxylase, P-enolpyruvate carboxykinase, and P-enolpyruvate carboxytransphosphorylase. Because propionyl-CoA carboxylase and pyruvate carboxylase are biotin enzymes, they would be expected to have similar mechanisms. Likewise the reactions catalyzed by P-enolpyruvate carboxykinase and carboxytransphosphorylase are in some respects similar to that of P-enolpyruvate carboxylase, and it has been suggested that bicarbonate might be the reactant in each case. By means of radiochemical and spectrophotometric techniques, we have obtained evidence that the active species in the carboxykinase and carboxytransphosphorylase reactions is CO2 and not bicarbonate. Bicarbonate appears to be the active species in the pyruvate carboxylase reaction, in conformity with the results obtained with propionyl-CoA carboxylase. Author

N70-23309*# New York Univ., N.Y.
COMPARISON OF ENZYMATIC CARBOXYLATION MECHANISMS
M. Daniel Lane *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 195–206 refs (See N70-23290 10-04)
(Grants PHS-AM-0916; PHS-AM-09117; PHS-K3-AM-18487)
Avail: SOD $2.75; CFSTI CSCL 07C

Reviewed and compared are basic chemical problems and types of enzymatic carboxylation with emphasis on the carboxylation mechanisms of biotin and PEP. It is shown that the enzyme plays an important role in the stabilization of the carbanion. Evidence is presented that biotin is active in the enzymatic carboxylation of pyruvate, prionyl CoA, and acetyl CoA. Comparison of the three different enzymatic PEP carboxylation reactions and the related pyruvate kinase- catalyzed reaction show a striking similarity between the structures of the ternary enzyme-metal-PEP complexes of PEP carboxy-kinase and PEP carbocylase because all three enzymes catalyze homologous reactions of PEP; PEP undergoes nucleophylic attack on its phosphoryl group, tautomerizes and accepts a charged group on its #3 carbon atom. The essential difference in these reactions is the nature of the phosphoryl group acceptor and the electrophile which adds to PEP. G.G.

N70-23310*# Rutgers Univ., New Brunswick, N.J. Medical School.
THE ROLE OF BOUND METAL IONS IN CO2 FIXATION BY THE BIOTIN CARBOXYLASES
M. C. Scrutton and A. S. Mildvan (Pennsylvania Univ.) *In* NASA, Washington CO2: Chem., Biochem., and Physiol. Aspects 1969 p 207–223 refs (See N70-23290 10-04)
(Contract AT(11-1)-1242; Grants PHS-AM-09857; PHS-AM-09760; PHS-AM-11712; PHS-GM-08320 et al)
Avail: SOD $2.75; CFSTI CSCL 07C

The studies described confirm earlier speculation based

on theoretical considerations and model studies that metal ions play an important role in enzymic carboxylation and decarboxylation reactions. The recognition of manganese as the metal ion involved in carboxylation of pyruvate in avian liver has been of special interest because it has provided the first example of a manganese metalloprotein and, by virtue of the paramagnetic properties of this metal ion, has permitted us to use nuclear magnetic resonance techniques in our studies of its role in catalysis. Pyruvate carboxylase is suggested as a key enzyme in gluconeogenesis from three-cargon precursors; e.g., lactate. If a sufficiently severe manganese deficiency can be induced, a direct test of the role of pyruvate carboxylase in gluconeogenesis should be feasible. Author

N70-23331# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF THE THIN-LAYER CHROMATOGRAPHY METHOD FOR SEPARATION OF FERROCENE DERIVATIVES

N. Ya. Maryaskin et al 5 Aug. 1969 8 p refs Transl. into ENGLISH from Tr. Inst. Neftekhim. i Gaz. Prom. (Moscow), no. 72, 1967 p 67–70

(AD-698438; FTD-HT-23-393-69) Avail: CFSTI CSCL 7/3

Conditions are developed for separating ferrocene derivatives on aluminum oxide in a thin layer and for determining the retention times, R(f) for these compounds. Preparative thin-layer chromatography was used to separate eight acetylene derivatives of ferrocene, of which six have not been described in the literature. These included: (1-ethoxy-1-methylpropynyl)ferrocene, 1-acetyl-1'-(1-hydroxyl-1-methylpropynl)ferrocene, and 1-benzoyl-1'-(1-hydroxy-1-phenylpropynyl)ferrocene. Author (TAB)

N70-23359# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SYNTHESIS AND TESTING OF SALTS AND DIESTERDITHIOPHOSPHORIC ACIDS AND LUBRICATING OIL ADDITIVES

A. M. Kuliev et al 20 Aug. 1969 8 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Neft i Gaz (USSR), v. 8, no. 5, 1968 p 55–57

(AD-698534; FTD-HT-23-382-69) Avail: CFSTI CSCL 11/8

Six new diesters of phosphorodithioic acids were obtained by reacting esters of glycerin alpha-monochlorohydrin, alkylphenols, alkylthiophenols, and alpha-naphthol with phosphorus pentasulfide. It was established that zinc salts of these acids increase the generalized wear index and reduce the corrosion of oil TAP-15. Author (TAB)

N70-23361# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATING ELECTROEROSIONAL PHENOMENA ON THE SURFACE OF A TWO-LAYERED ELECTRODE

I. A. Bakuto et al 15 Aug. 1969 13 p refs Transl. into ENGLISH from Tr. Soveshch. Elektr. Kontakt. i Kontakt. Materialam, 4th (Moscow), 1967 p 70–77

(AD-698539; FTD-MT-24-183-69) Avail: CFSTI CSCL 9/1

Bimetal electrodes Cu-Sn and Sn-Bi were prepared and used as anodes vs. a conical Fe cathode during sq. pulse discharges (900 A at 240 Mu sec) in kerosene. The Cu-Sn layers were perpendicular, while Sn-Bi were parallel to the axis of the discharge. After a series of discharges, erosion was determined by the weight loss method, and the discharge area observed with a microscope. The erosion values of the 2-layer electrode and the Fe cathode were plotted vs. the thickness of the Cu layer. The erosion of both electrodes decreased when the thickness of the Cu layer increased within the range 0.02-1 mm. A similar relation was observed between the area of erosion and Cu thickness. The exponential results were analyzed on the basis of the migration theory for the mechanism of electric erosion. The derived equations defining erosion losses of 2-layer electrodes are in agreement with exponential data. A linear relation exists between the erosion losses of Bi and Sn when the 2 layers are parallel to the discharge axis. The good agreement between the exigencies of the migration theory and exponential results in both cases offers a possibility for evaluating erosion under different conditions. The theoretical conceptions can be very helpful for the practical estimation of plasma electric discharges between metal electrodes. Author (TAB)

N70-23363# National Bureau of Standards, Washington, D.C. Inst. for Basic Standards.

BIBLIOGRAPHY ON ATOMIC TRANSITION PROBABILITIES, JANUARY 1916–JUNE 1969

B. M. Miles and W. L. Wiese Feb. 1970 110 p refs

(NBS-SP-320) Avail: SOD $1.25

The papers, except for a number of comprehensive articles, are arranged according to elements and stages of ionization. In addition to the literature reference the employed experimental or theoretical method is indicated. For the 20 lightest elements and Ba I and II the literature is presented on a critically selected basis. A number of comprehensive papers which contain numerical results throughout extended isoelectronic sequences are listed in a separate section. A supplementary list of selected important papers dealing with the subject from a general point of view is also included. Author

N70-23369*# TWR Systems, Redondo Beach, Calif. Applied Mechanics Lab.

A STUDY TO ANALYZE THE PERMEATION OF HIGH DENSITY GASES AND PROPELLANT VAPORS THROUGH SINGLE LAYER TEFLON OR TEFLON STRUCTURE MATERIALS AND LAMINATIONS Final Report, 5 Jul. 1968–28 Jul. 1969

R. L. Johnson 15 Aug. 1969 112 p refs Prepared for JPL

(Contract NAS7-505)

(NASA-CR-109345; TRW-07282-6032-R0-00) Avail: CFSTI CSCL 07D

Results of a study designed to investigate the leakage rate of pressurant gases and propellant vapors through laminated bladder structures containing an impermeable diffusion barrier as one of the laminates are reported. Under the second phase of the program the formation and growth of vapor bubbles on the bladder surface within the liquid propellant was investigated. The solubility and diffusivity of helium and nitrogen pressurant gases in the liquid propellants N2O4 and N2H4 were also measured and the computer program previously developed was extended to include the effects of gas vapor on the liquid side of the bladder. In addition, the diffusivity of the gases nitrogen and helium in the space storable propellant vapors OF2 and B2H6 as well as N2O4 and N2H4 were determined experimentally. Author

N70-23382*# Brigham Young Univ., Provo, Utah.

STUDIES OF REACTION GEOMETRY IN OXIDATION AND REDUCTION OF THE ALKALINE SILVER ELECTRODE Quarterly Report

Eliot A. Butler and Angus U. Blackham 15 Feb. 1970 30 p refs Prepared for JPL

(Contracts NAS7-100; JPL-952268)

(NASA-CR-109348; QR-7) Avail: CFSTI CSCL 07D

A new series of electrodes was constructed to be used in the determination of electrolyte resistance as a function of pore size. Oscillations were observed in portions of all the potential curves obtained during the constant current oxidations. A theoretical growth pattern of oxide is proposed to describe electrode processes which could cause the oscillations. It is similar to one proposed by Thirsk for plane electrodes. Qualitative descriptions of some electrode phenomena are also given. Author

N70-23386# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Inst. fuer Turbulenzforschung.

THERMODYNAMIC EQUATIONS OF STATE IN CLOSED

ANALYTICAL FORM FOR DISSOCIATED AND IONIZED AIR IN EQUILIBRIUM [THERMODYNAMISCHE ZUSTANDSGLEICHUNGEN IN GESCHLOSSENER FORM FUER DIE DISSOZIIERENDE UND IONISIERENDE LUFT IM GLEICHGEWICHTSZUSTAND]

Michael Jischa (Tech. Univ. Berlin) Nov. 1969 50 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-81) Avail: CFSTI

The equations of state based on the Hansen model configuration for air consisting of 80 mol percent nitrogen and 20 mol percent oxygen were derived. Appropriate relationships concerning the law of mass action due to Lighthill for the dissociation and Duclos et al for the ionization were introduced from which it was possible to express the quantities such as the compressibility factor, internal energy, enthalpy, specific heats, their quotient and the speed of sound. The results were compared with the calculations of Hilsenrath and Klein and those of Hansen for temperatures up to 16,000 K and a pressure-range of 104 to 100 atm. and found to be in good agreement. Author (ESRO)

N70-23405# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Raketentreibstoffe

PRINCIPLES OF SPECTROSCOPY AND THEIR APPLICATION TO PROPULSION PROBLEMS OF ROCKETS [GRUNDLAGEN SPEKTROSKOPIE MIT ANWENDUNG AUF RAKETENTECHNISCHE FRAGEN]

L. Krauss, M. Mailaender, H. Meinel, and W. Stricker Oct. 1969 47 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Wiss. Forsch.
(BMwF-FB-W-69-41) Avail: CFSTI

The basic elements of spectroscopic terminology and the hot molecular gas behavior are dealt within principle, and the determination of the dissociation energies of molecules by spectroscopic methods is described. The relation between thermodynamics and spectroscopy is shown by use of some examples. In addition, the basis of optical temperature measurements are outlined, and conclusions are drawn for rocket propellant temperature ranges. Author (ESRO)

N70-23437# San Diego State Coll., Calif.

NEIGHBORING PEROXIDE GROUP REACTIONS Final Report, 1 Jun. 1965 - 31 Aug. 1969

William H. Richardson Aug. 1969 6 p refs
(Grant DA-ARO(D)-31-124-G657)
(AD-698470; AROD-5546-6-C) Avail: CFSTI CSCL 7/3

A kinetic and product study was made to determine the possibility of neighboring hydroperoxy, peroxide anion, and peroxide group reactions. Author (TAB)

N70-23456 Pennsylvania Univ., Philadelphia.

PROPERTIES OF METAL-SOLUTIONS: VOLUME CHANGE, CONDUCTANCE, PROTON AND NITROGEN MAGNETIC RESONANCE

Richard Haynes (Ph.D. Thesis) 1969 318 p
Avail: Univ. Microfilms: HC $14.40/Microfilm $4.10 Order No. 69-21365

The purpose of this work was to prepare models to explain the volume expansion and electrical conductance in dilute metal solutions where information was available and to obtain new data on proton and nitrogen magnetic resonance. A procedure for calculating the volume change in metal solutions is introduced based on the changes in the structure of the solvent upon introducing various species into the solution. This procedure was used to calculate the excess volume in metal-ammonia solutions. General conditions for the existence of a volume minimum for each method were obtained. Under certain conditions the existence of a minimum could be explained. A mechanism for the electrical conductance in the dilute concentration regions based on the formation of new cavities produced through the rotational motion of the solvent molecules associated with the electron is presented. This model is used to explain: (1) the high mobility of the electrons in concentration regions below the conductance minimum; (2) dependence of the mobility on the solvent, and; (3) a constant Walden product for various metal solutions. Dissert. Abstr.

N70-23457*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

THE ROLE OF THE STRUCTURE OF SURFACE LAYERS IN THE PROCESS OF EXTERNAL FRICTION OF POLYMER MATERIALS [ROL' STRUKTURY POVERKHNOSTNYKH SLOYEV V PROTSESSE VNESHNEGO TRENIYA POLIMERNYKH MATERIALOV]

V. A. Beliy Washington NASA Mar. 1970 34 p Transl. into ENGLISH from Proceedings of the All-Union Sym. on the Nature of Friction in Solids (Minsk), 1969 p 35-68
(Contract NASw-2034)
(NASA-TT-F-12890) Avail: CFSTI CSCL 07D

The unusually important role of structure in friction of polymers and the considerable prospects offered by studies that were conducted in this area are covered in this survey. Their goal was the compilation of prerequisites for analyzing new frictional materials with specific structures and properties, as well as contributing to an understanding of friction in solids. Author

N70-23498# Washington Univ., St. Louis, Mo. Lab. for Space Physics.

THE MICROANALYSIS USING FISSION TRACKS

M. W. Hair, J. Kaufhold, M. Maurette, and R. M. Walker [1969] 12 p refs
(Grant NSF GA-1460)
Avail: Issuing Activity

Measurements of standard powdered rock samples indicates an absolute accuracy of less than 10% for concentrations greater than 0.1 ppm. This conclusion is verified by further comparisons based on specially fabricated trace Th glasses and certain natural obsidian samples. The technique used also measures the U concentration of the unknowns. Working with obsidian artifacts and obsidian mine samples from the Aegean region U-Th groupings were found that agree with previous groupings that were based on Ba and Zr analyses. The outstanding advantage of the fission track methods for Th determination is the ability to make absolute determinations on very tiny samples and to do micromapping of the Th distribution in larger samples. As an example, some of the powdered rock standards were found to be inhomogeneous on a microscale giving rise to sunburst patterns of fission tracks. Author

N70-23529 National Lending Library for Science and Technology, Boston Spa (England).

THERMODYNAMIC EQUILIBRIA IN THE S-H2O Se-H2O AND Te-H2O SYSTEMS IN THE TEMPERATURE RANGE 25-300 C AND THEIR GEOCHEMICAL INTERPRETATIONS

I. B. Dyachkova et al 22 Oct. 1969 10 p refs Transl. into ENGLISH from Geokhim. (Moscow), no. 11, 1968 p 1358-1375 In ENGLISH and RUSSIAN
(NLL-Trans-746-262-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

On the basis of recent data on the thermodynamic properties of compounds in the systems S-H2O, Se-H2O and Te-H2O and an improved method for calculating these properties at elevated temperatures, the Eh-pH stability field diagrams were plotted for various forms of sulfur, selenium and tellurium at 25, 150 and 300 C. A comparative analysis of these diagrams shows that the separation of sulfur, selenium and tellurium in processes occurring with the participation of aqueous solutions may be determined by changes in the redox potential, acidity and temperature of these solutions. The most important of these factors is the redox potential of the environment. Maximum separation of sulfur, selenium

and tellurium in hydrothermal processes may be expected to be observed under oxidizing conditions, at lowered temperatures and weakly-alkaline pH values. Author

N70-23531# Aerochem Research Labs., Inc., Princeton, N.J.
THERMODYNAMIC STUDIES IN METAL CONTAINING FLAMES
J. E. Jensen and W. J. Miller Oct. 1969 30 p refs
(Contract NONR-3809(00))
(AD-698559; TP-223) Avail: CFSTI CSCL 21/2

Several different experimental techniques (flame-ion mass spectrometry microwave cavity resonance, electrostatic probes and absorption spectrophotometry) were applied to fuel-rich atmospheric-pressure H2/O2/N2 flames seeded with potassium in order to determine the thermochemistry of ions produced from additives containing tungsten, boron or tin. Addition of tungsten results in reductions in concentrations of free potassium atoms and in formation of stable W-containing negative ions. The derived enthalpy changes imply electron affinities for WO3 and HWO4 of approximately 305 and 400 kj/mole, respectively. The reaction K + H2WO4 = KHWO4 + H is found to be exothermic. Comparison of the apparently rapidly established dissociative electron attachments to HBO2 and HCl provides a value for the electron affinity of BO2. Reactions leading to formation of BO(-) are discussed, and a lower limit for the electron affinity of BO of approximately 240 kj/mole is obtained. An examination of the positive ions produced by addition of tin compounds to these flames leads to a zero-point standard heat of formation for SnOH(+)(g). Author (TAB)

N70-23558# Purdue Univ., Lafayette, Ind. Project SQUID Headquarters.
MECHANISM OF PRODUCTION OF CN AT HIGH TEMPERATURES IN N2-C2 H2 MIXTURES
S. H. Buer (Cornell Univ.), Akiva Bar-Nun (Cornell Univ.), and David Lewis (Cornell Univ.) Jun. 1969 84 p refs
(Contract N00014-67-A-0226-0005)
(AD-698284; SQUID-TR-CU-1-PU) Avail: CFSTI CSCL 7/4

Mixtures of acetylene and nitrogen, highly diluted in argon were subjected to reflected shock temperatures, 2244-4923K, at total pressures up to 550 cm Hg. Changes in sample compositions were followed spectrophotometrically by photographing the total emission spectrum, by recording relative emission intensities as a function of time over selected narrow band widths, and by measuring time dependent absorptions of characteristic radiation at the (0,0) band heads of C2 and CN. The effect of added oxygen (20ppm level) was tested. The results served to eliminate several simplistic mechanisms, and point to the necessity for considering a somewhat extended chain of coupled radical reactions. Author (TAB)

N70-23563# Institute of Modern Languages, Inc., Washington, D.C. Translation and Interpretation Div.
HYDROGENATION OF BENZENE AND CERTAIN OF ITS DERIVATIVES ON THE RODIUM-PLATINUM ALLOY CATALYST IN THE LIQUID PHASE
D. V. Sokol'skiy et al Dec. 1969 11 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavednii (Russian), v. 11, no. 1, 1968
(Contract DAAK02-68-C-0396)
(AD-698454; T-1968-69) Avail: CFSTI CSCL 7/3

A study was made of the effect of various hydrocarbon side groups on the hydrogenation of benzene. According to their hydrogenation speed, the studied compounds appear in the following order: benzene > ethyl-benzene > toluene > n-xylene > m-xylene > o-xylene. The order of reaction, according to substance being hydrogenated, for benzene and o-xylene, is a zero order; for the remaining investigated compounds it is close to zeroth order. For the first time it has been shown that the hydrogenation of benzene and its homologues takes place with insignificant displacement of potential. The small displacement of potential makes it possible to assume that the adsorption takes place on the catalyst, the surface of which is occupied by hydrogen. The alcohol displaces aromatic hydrocarbons from the surface of the catalyst, and the reaction does not take place. Author (TAB)

N70-23565# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
ELECTRON DENSITY DISTRIBUTION IN CERTAIN FLUORIDES AND OXYCHLORIDES [RASPREDELENIYE ELEKTRONNOY PLOTNOSTI V NEKOTORYKH FTORIDAKH I OKSIKHLORIDAKH]
S. I. Ionov et al Oct. 1969 6 p refs Transl. into ENGLISH from Z. Neorgan. Khim. (Russian), v. 14, no. 6, 1969 p 1691-1692
Prepared for Lincoln Lab., MIT
(AZT-69-643-RULL) Avail: CFSTI

Computations are made of the electron density distribution in several molecular systems: CF4, SiF4, ClO4-(T sub d symmetry), ClO3, ClO3(-), ClO3FIC sub 3v symmetry). A table is given of the results. Author

N70-23573# Commissariat a l'Energie Atomique, Marcoule (France). Centre de Production de Plutonium.
PROPERTIES AND RECENT APPLICATIONS OF NITROGEN OXIDES NO AND NO2: LITERATURE SURVEY FROM 1960 TO 1968 [PROPRIETES ET APPLICATIONS RECENTES DES OXYDES D'AZOTE NO ET NO2: ETUDE BIBLIOGRAPHIQUE DE 1960 A 1968]
Jacqueline-Marguerite Auchapt Dec. 1969 69 p refs In FRENCH; ENGLISH summary
(CEA-BIB-172) Avail: CFSTI

This review of recent work on the nitrogen oxides NO and NO2 covers three aspects: their natural state, their presence as by-products or as synthetic produces in industry, and their use as raw materials or propellants. Possible new applications to materials and normal living conditions, as well as to new and complex industrial processes such as radiolysis or radiochemistry, and the incidental presence of these substances in both nuclear and conventional industries were studied in the last decade. This literature survey shows that (a) the natural state of these oxides undergoes very particular changes, since their presence in the lower layers of the atmosphere is due only to increasing pollution caused by the progress of combustion engines and their more widespread use; (b) their elimination occurs through fairly conventional processes; (c) their production in chemico-nuclear power stations constitutes a very promising new technique. Author (ESRO)

N70-23587 Polytechnic Inst. of Brooklyn, N.Y.
STEREOCHEMISTRY OF POLYACETALDEHYDE MODEL COMPOUNDS
Gregory C.-C. Niu (Ph.D. Thesis) 1969 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-20353

The purpose of this research was to prepare a set of stereo-specific polyacetaldehyde model compounds and to study their conformational aspects. These structures were obtained by synthesizing dimethyl acetal or acetaldehyde (monomeric model compound), meso and racemic alpha,alpha'-dimethoxydiethyl acetal of acetaldehyde (trimeric model compounds). The high-resolution nmr spectra of these compounds were determined and assigned. Dipole moment measurements and minimum potential energy calculations for these compounds (along with calculated dipole moments corresponding to most stable conformations) were carried out. The isotactic trimer model compound was found to have similar internal rotation angles at the potential energy minimum to crystalline isotactic polyacetaldehyde where the internal rotation angles were deduced from X-ray crystallographic data. Dissert. Abstr.

N70-23592 National Lending Library for Science and Technology, Boston Spa (England).
KINETICS OF NICKEL CARBONYL SYNTHESIS
A. Y. Kipnis et al 21 Jul. 1969 13 p refs Transl. into ENGLISH from Tr. Poekt. Nauch.-Issled. Inst. Gipronikel (USSR), no. 30, 1966 p 50–56 In ENGLISH and RUSSIAN
(NLL-LTI-746-156-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Experimental data on the rate of the reaction of nickel carbonyl with carbon monoxide at CO partial pressures of 1 atm. or less were used to evaluate the kinetic characteristics of the reaction. The energy of activation was found 6.9 kcal/mole and the order of the reaction, 0.6. It was confirmed that a maximum exists on the reaction rate vs. temperature curve at about 75 C. The reaction rate was found to change irreversibly as a result of temperature fluctuation. Author

N70-23593 Columbia Univ., New York.
LIFETIME SHORTENING OF *Na*(3 2P) AND TI(7 2S) QUENCHED BY HALOGENS
Louis Eugene Brus (Ph.D. Thesis) 1969 57 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20168

The time dependence of Na(3-2P) fluorescence produced by pulsed, far ultraviolet photodissociation of NaI vapor at 600 C has been directly observed via the method of single photon counting. The experimental apparatus and procedure are described. Collisionless NaI molecules photodissociate in a time much less than 1 nsec., and the fluorescence decay is exponential with tau = 16.0 + or − .2 nsec. Energetic considerations indicate that ground state is also produced. No evidence of collision induced fluorescence is seen. Quenching of the fluorescence by NaI vapor itself is not observed, setting an upper limit of approximately 15 A(2) for the cross section of this process. Quenching by iodine vapor is studied as a function of pressure, and I2 molecules are shown to be at least 30 times more more effective quenchers than I atoms. The velocity dependence of the I2 cross section is studied by varying the photodissociation pulse wavelength. Dissert. Abstr.

N70-23596# Joint Publications Research Service, Washington, D.C.
ESTIMATING THE MOLECULAR WEIGHT OF THE ANOMALOUS COMPONENT OF MODIFIED WATER BY THE CRYOSCOPIC METHOD
B. V. Deryagin et al 5 Mar. 1970 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR Ser. Khim., (Moscow), v. 189, nos. 4–6 1969 p 1282–1285
(JPRS-49986) Avail: CFSTI

The hypothesis that the anomalous component (ac) entering into the composition of modified water is heavy water is supported. The mean molecular weight of the anomalous component indicated that it was ultimately modified water(umw). The possibility that umw contains a certain amount of conventional water was not excluded. Using a cryoscopic method, an estimation of the molecular weight of the ac was shown to exceed previous datum. This variation in molecular weight explains the difference in the properties between modified and conventional water. S.S.

N70-23599# National Bureau of Standards, Washington, D.C. Analytical Coordination Chemistry Section.
ANALYTICAL COORDINATION CHEMISTRY SECTION: SUMMARY OF ACTIVITIES JULY 1968 TO JUNE 1969
Oscar Menis, ed. Oct. 1969 121 p refs
(NBS-TN-504) Avail: SOD $1.00

Research developments are described in flame emission and atomic absorption spectrometry, spectrophotometry, spectrofluorometry, differential thermal analysis and the analysis and certification of Standard Reference Materials. Procedures, analytical data and background information are presented for Standard Reference Materials of steels, cast and nodular irons, ferrosilicon, high-purity materials, neutron flux monitor wire, organo-metallic compounds, glasses, and clays. These descriptions include atomic absorption methods for copper in steel, magnesium in nodular iron, impurities in calcium carbonate, high precision spectrophotometric methods for cobalt in aluminum wire, molybdenum and tungsten in microprobe standard, traces of iron and copper in high purity gold and methods for the determination of silica and aluminum in clays. Author

N70-23610# Southern Illinois Univ., Carbondale.
THE NATURE OF INTERMEDIATES IN SURFACE REACTIONS: THE MECHANISM OF DEUTEROGENATION Final Report, 10 Oct. 1966 – 10 Oct. 1968
Gerard V. Smith Dec. 1969 24 p refs
(Contract DA-ARO(D)-31-124-G862)
(AD-698583) Avail: CFSTI CSCL 7/3

The document is a final report of a project whose general goal was to discover new knowledge about the mechanism of heterogeneous catalytic hydrogenation (Deuteriogenation). Specifically, it was proposed to use (+)-1,3-dimethyl-cyclohexene and its isomers as molecular probes of the catalytic surface. By comparing the amounts of exchange and optical purity of both the recovered desorbed olefin and trans product it was anticipated that a choice could be made between the various surface intermediates which have been proposed in the literature. Although progress was made on preparing and purifying (+)-1,3-dimethylcyclohexene, other pathways were found which yielded valuable information of similar nature and these were largely pursued during the grant period. These pathways included the hydrogenation and exchange of 2-pinene and 6,6-dimethyl-2-norpinene (apopinine). Also discussed are the catalytic hydrogenation and exchange of styrenes with tris(triphenylphosphine)-chloro rhodium. Author (TAB)

N70-23620 National Lending Library for Science and Technology, Boston Spa (England).
BLACK CHROMIUM PLATING BATHS CONTAINING HYDROGEN SILICOFLUORIDE. PART 1: STUDIES OF COLOURED CHROMIUM PLATING [KEIFUSSAN KEI KOKUSHOKU KUROMU MEKKI YOKU NO KENTO. USHOKU KUROMU MEKKI NO KENKYU DAI IPPO]
K. Aotani Nov. 1969 14 p refs Transl. into ENGLISH from Kinzoku Hyomen Gijutsu (Tokyo), v. 19, no. 9, 1968 10 p
(NLL-RTS-5422) Avail: Natl. Lending Library, Boston Spa, Engl.: 15s or 1 NLL photocopy coupons

Several plating bath systems were investigated to obtain information on the composition of electrodeposits, crystallization structure, and coloration mechanism. Data is given on bath systems based on acetic acid, formic acid, sulfamic acid, and hydrogen silicofluoride systems. Electroplating was achieved with these additives, with formic acid giving the best coloration, followed by acetic acid, but the precipitate was lusterless and powdery. Sulfamic acid and the fluoride were not satisfactory. Best color and uniformity of blackness were obtained with a high current density and low temperature. A further detailed study using hydrogen silicofluoride was made, and the properties of the most satisfactory bath were determined. Hydrogen silicofluoride must be replenished as it is used up, and the sulfuric acid must be removed. The throwing power of the bath is improved by nickel or copper plating and by carrying out black chromium plating immediately after this plating. N.E.N.

N70-23624# Aztec School of Languages, Inc., Maynard, Mass.
ON THE INTERPRETATION OF SPECTRAL LINE BROADENING BY FOREIGN GASES [ZUR INTERPRETATION DER FREMDDRUCKVERBREITERUNG VON SPEKTRALLINIEN]
W. Behmenburg Jan. 1970 22 p refs Transl. into ENGLISH from Z. Astrophysik (Germany), v. 69, no. 5, 1968 p 368–384
Prepared for Lincoln Lab., MIT
(AZT-70-56-GELL) Avail: CFSTI

Halfwidth, shift and asymmetry ratio of spectral lines broadened by neutral atoms are calculated on the basis of the Lindholm theory for general pressures, assuming a Lennard–Jones potential for the interaction. The calculations are compared with measurements of pressure and temperature effects of argon and neon on the Cs 8943 A line. In the case of argon there is good agreement; in the case of neon considerable deviations are observed. The deviations are discussed considering the basic assumptions of the theory. Author

N70-23625# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

ULTRAVIOLET OPTICAL ABSORPTION OF COBALT AND NICKEL IN THIN FILMS [ABSORPTION OPTIQUE ULTRAVIOLETTE DUE COBALT ET DU NICKEL EN COUNCHES MINCES]

Max Belzons et al Nov. 1969 7 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 261, no. 20, 1965 p 4042–4045 Prepared for Lincoln Lab., MIT
(AZT-69-629-FRLL) Avail: CFSTI

How the hypothesis of an abnormal optical absorption by cobalt and nickel in thin films appears jusitified by the results of studying the absorption spectra of an NaCl crystal containing Co(2+) and Ni(2+) ions as impurities. Author

N70-23630 National Lending Library for Science and Technology, Boston Spa (England).

THE SEPARATION OF HYDROGEN ISOTOPES ON A PALLADIUM CATHODE

G. N. Trusov et al 4 Nov. 1969 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), no. 138, 1961
(NLL-WH-Trans-267-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The effects on the separation coefficient of the properties of tritium and protium surface layers on palladium foil electrodes were measured. Cathodic and anodic overvoltage curves were determined for electrodes after saturation with constant current, during saturation with an alternating current, and activated palladium electrode. The dependence of the separation coefficient on polarization with an alternating current, with an interrupted current, and with a constant current was also found. The results show that the separation coefficient is close to unity, and the deviations are discussed. N.E.N.

N70-23637# RAND Corp., Santa Monica, Calif.

DIAMOND, GRAPHITE, CARBYNE: THE ALLOTROPIC FORMS OF CARBON [ALMAX, GRAFIT, KARBIN: ALLOTROPNYE FORMY UGLERODA]

A. M. Sladkov et al Dec. 1969 27 p refs Transl. into ENGLISH from Priroda (Moscow), no. 5, May 1969 p 37–44
(AD-698774; LT-69-32) Avail: CFSTI CSCL 7/2

A discussion is given of an allotropic form of carbon which is called carbyne in relationship to graphite and diamond. Carbyne is reported to be a combination of polyethynylene and polymethanetetrayl. TAB

N70-23646# National Bureau of Standards, Washington, D.C. Physical Chemistry Div.

HYDROGEN FLUORIDE AND THE THERMOCHEMISTRY OF FLUORINE

George T. Armstrong Feb. 1970 21 p refs
(NBS-TN-513) Avail: SOD $0.30

The thermochemistry of hydrogen fluoride is reviewed. The principal emphasis is on the experimental basis of the heats of formation of HF(g) and of HF(aq). Data from flame calorimetry in which HF(g) and HF(aq) are formed, evidence from processes involving other fluorine compounds, and some evidence from spectroscopic and photo-dissociation studies are brought together. Author

N70-23655*# California Univ., Berkeley. Sea Water Conversion Lab.

STUDY OF PERMEABILITY CHARACTERISTICS OF MEMBRANES Quarterly Report, 9 May–9 Aug. 1969

K. S. Spiegler, J. C. T. Kwak, D. A. Zelman, and J. Leibovitz 9 Aug. 1969 24 p Prepared for JPL
(Contracts NAS7-100; JPL-952109)
(NASA-CR-109355; QR-7) Avail: CFSTI CSCL 07A

Some improvements in the experimental system, including the use of a sealed, magnetically driven gear pump, and insertion of several mixed bed ion exchange columns in the demineralizing system are described. A detailed account of a transport experiment is given. All factors necessary for calculating the salt and volume transport through the membrane are considered and the final equations relating salt and volume flow to the data recorded for each half-cell are given. Author

N70-23659 National Lending Library for Science and Technology, Boston Spa (England).

RESEARCH ON PHOSPHORUS ORES. PART 2: CHANGES CAUSED BY CALCINATION IN PHOSPHORUS ORES [RIN KOSEKI NO SHOSEI HENKA. HRIN KOSEKI NO KENKYU, DAI 2 HO]

J. Ando et al Nov. 1969 20 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Japanese), v. 68, no. 7, 1965 12 p
(NLL-RTS-5467) Avail: Natl. Lending Library, Boston Spa, Engl.: 17s 6d or 2 NLL photocopy coupons

When the usual kind of phosphate ores such as Florida, Macatea, Morocco, Tiber, Gafsa, Kosha, etc. are heated, there is a temporary drop in the crystallinity of the apatite which is the main constituent of the phosphorus ore, around 500 C and crystalline growth begins above 700 C. The citric solubility of the uncalcined phosphate ores between 65 deg/o(Gafsa) and 29 deg/o(Tiber) depending on the size of the apatite crystals and the quality of the ore; with calcining at 500 C, there is a slight rise in citric solubility in some of the ores, and with calcining above 700 C, there is a drop in citric solubility in all cases. The amount of organic matter in phosphates varies greatly according to the ore. The thermal decompositon pattern also varies but in most cases removal is largely complete as a result of calcining up to 900 C. The exothermic amount observed at 300 to 700 C in the differential thermal analysis curves of phosphates corresponds almost exactly to the amount of organic matter in the ores. Author

N70-23678# Naval Postgraduate School, Monterey, Calif.

OBJECTIVE IDENTIFICATION PROCEDURES FOR THE NAVAL OIL ANALYSIS PROGRAM

Donald R. Barr and Harold J. Larson Sep. 1969 53 p refs
(AD-698497; NPS-55Bn-La9091A) Avail: CFSTI CSCL 11/8

A class of rules is developed for making decisions concerning whether a mechanical system may be failing, based upon spectroscopic analyses of the systems oil over a period of time. Some considerations that went into the development of these rules, including conclusions based upon studies of certain analysis records and experiments, are presented. It is indicated that these identification procedures should perform well in connection with a computerized analysis system, at least insofar as routinely monitoring the well behaved systems, while calling the attention of appropriate personnel to possibly discrepant systems. Author (TAB)

N70-23684# National Bureau of Standards, Washington, D.C. Inorganic Materials Div.

ARPA-NBS PROGRAM OF RESEARCH ON HIGH TEMPERATURE MATERIALS AND LASER MATERIALS, 1 JANUARY–30 JUNE 1969

A. D. Franklin and H. S. Bennett, eds. Jan. 1970 99 p refs Supported by ARPA
(NBS-TN-514) Avail: SOD $1.00

Brief reviews are given of work performed during the period

January 1 to June 30, 1969, on a number of projects concerned with high temperature materials and with laser materials. Under the high temperature materials heading, topics include diffusion of oxygen in oxides, growth of Al2O3 crystals by chemical vapor deposition, the electronic structure of transition metal borides and related compounds, the optical constants of titanium, high temperature creep in copper, fracture in glass, the mechanism of volatilization of polymers and long chain compounds, and the interaction between mechanical relaxation and annealing in polymers. Work on laser materials includes measurement of bulk optical and elastic properties of laser materials, a study of the "orange" degradation of ruby, measurements of sub-crystal misalignment in ruby, damage in glass induced by high energy laser pulses, chemical analyses for ruby and Nd-doped laser glasses, and preliminary studies on detection of submicroscopic inhomogeneities in glass. Author

N70-23686 National Lending Library for Science and Technology, Boston Spa (England).
EXPANSION OF EXPLOSIVE MIXTURES
G. Schoen Aug. 1969 23 p refs Transl. into ENGLISH from Erdoel Kohle Erdgas Petrochemie, (Hamburg), v. 20, no. 10, 1967 p 714–720
(NLL-Trans-2010-6180.59) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Following the discussion of the characteristics of flammable fuel vapour/air mixtures, e.g. explosion limits and explosion points, as well as their correlation to the vapour pressure and boiling curves determining the production of explosive mixtures, the mixture propagation in tanks by diffusion, conditions necessary for the existence of convection flow, and the turbulent mixing processes are described. From measurements of the mass flow and of concentrations of mixtures leaving the fuel tank, it is possible to determine the losses due to tank respiration and fuel transfer which occur during normal storage, together with transloading. Under usual operating conditions, the total losses amount to about 1.5 to 3 % of the transloaded fuel. Finally the expansion of mixtures in the free atmosphere when the air is calm and its ground velocity small, and also the decrease of concentration in a free jet are discussed. Author

N70-23687# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
INFRARED INTENSIFICATION OF ULTRAVIOLET AND VISIBLE PHOTOLUMINESCENCE OF (Zn, Cd)S/Mn [RENFORCEMENT PAR L'INFRAROUGE DE LA PHOTOLUMINESCENCE ULTRAVIOLETTE ET VISIBLE DES (Zn,Cd)S/Mn]
A. Geoffroy and C. Marti Dec. 1969 10 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 268B, no. 25, 1969 p 1674–1677 In ENGLISH and FRENCH Prepared for Lincoln Lab., MIT
(AZT-70-42-FRLL) Avail: CFSTI

The study of the intensification of the characteristic emission of the manganese activator in (Zn, Cd)S (lambda = 5850 A) has been done as a function of the excitation wavelength at room temperature and at that of liquid nitrogen. An attempt to interpret this is made. Author

N70-23689# Aztec School of Languages, Inc., Acton, Mass.
OPTICAL PROPERTIES OF CHROMIUM [OPTICHESKIYE SVOYSTVA KHROMA]
M. M. Kirillova et al Dec. 1969 7 p refs Transl. into ENGLISH from Fiz. Metallov. Metallovedenie (Russian), v. 26, no. 5, Nov. 1968 p 952–955 Prepared for Lincoln Lab., MIT
(AZT-70-70-RULL) Avail: CFSTI

The optical properties of chromium are presented for two temperatures, 420 K and 293 K. Author

N70-23724# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
QUENCHING OF FLUORESCENCE IN SMALL MOLECULES
Jeffrey I. Steinfeld [1969] 33 p refs Sponsored in part by NSF and Am. Chem. Soc.
Avail: Issuing Activity

The fluorescence of excited molecules can be quenched by collisions, magnetic fields, or spontaneous dissociation. A summary of cross-sections for quenching by collision-induced predissociation is given for NO, I2, N2, HD, OH, CO, NO2, SO2, and CH3OH, and compared to the predictions of a model based on asymmetric van der Waals' interactions. A set of repulsive potential curves, consistent with all known spectroscopic and quenching data, is presented for I2. Author

N70-23728 National Lending Library for Science and Technology, Boston Spa (England).
SOME PROBLEMS OF USING HIGH-TEMPERATURE ORGANIC COOLANTS
O. A. Dibrov 4 Nov. 1968 4 p refs Transl. into ENGLISH from Khim. Prom. (Leningrad), v. 25, no. 8, 1968 p 589
(NLL-Trans-2134-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Insufficient data on aromatized oil AMT-300 and ditolyl methane and inconsistent requirements are identified as the main reasons for the lack of use of these coolants in industry. The primary application mentioned is steam boilers, and it is recommended that a study be undertaken to work out all-union recommendations and rules for their use. N.E.N.

N70-23738# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics.
THE SPECTRA OF DOUBLY AND TRIPLY IONIZED RARE EARTHS Final Report
H. M. Crosswhite and B. R. Judd 30 Sep. 1969 9 p refs
(Contract AF 49(638)-1497)
(AD-698784; AFOSR-69-2837TR) Avail: CFSTI CSCL 7/4

The parametric description of energy levels of rare earth ions was extended to include operators not previously taken into account. For FN-shell configurations these include the magnetic corrections (spin-other-orbit and spin-spin) derived from the relativistic Breit operator, as well as new effective operators describing configuration-mixing shifts induced by a mixture of electrostatic and spin-orbit perturbations. In the wavelength region 1200–3000 A the experimental spectra were measured and partially analyzed for Pr IV, Nd III and IV, Sm III, Gd IV, Dy IV, Er III and IV, and Tm III and IV. An extensive computer tape library was prepared which includes all Fn and FNd configurations of immediate interest. With these and the present knowledge of atomic structure parameters, it is now possible to anticipate the energy level structure of these configurations to better than 100/cm. The calculations also include relative transition probabilities in intermediate coupling and hence give a very good estimate of the location of the stronger lines. A very brief summary is given of these activities. Author (TAB)

N70-23782# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
NEAR-ULTRAVIOLET ABSORPTION SPECTRA OF DOUBLE CHLORIDES OF COBALT AND CESIUM. [SPECTRES D'ABSORPTION DES CHLORURES DOUBLES DE COBALT ET DE CESIUM DANS LE PROCHE ULTRAVIOLET]
Nicole Pelletier-Allard Nov. 1969 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 261, no. 5, 1965 p 1259–1262 Prepared for MIT, Lincoln Lab.
(AZT-69-628-FRLL) Avail: CFSTI

The absorption spectra of CoCs2Cl4 and CoCs3Cl5 have been produced in the near ultraviolet. The experimental results are given, as well as their theoretical interpretation. Author

N70-23837# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
STUDIES ON SILICON AND BORON [UNTERSUCHUNGEN

UEBER SILICIUM UND BOR]
L. Gatterman Dec. 1969 19 p Transl. into ENGLISH from Ber. der Deut. Chem. Ges., v. 22, 1889 p 186–197 Prepared for Lincoln Lab., MIT
(AZT-69-661-GELL) Avail: CFSTI

Experiments are described in which pure silicon and boron and halogen derivatives of both of these are produced from quartz sand and borax, respectively. Author

N70-23841 Harvard Univ., Cambridge, Mass.
X-RAY STUDIES IN THE BONDING AND STEREOCHEMISTRY OF SELECTED ORGANOTRANSITION METAL COMPOUNDS
Thomas Anthony O'Brien (Ph.D. Thesis) 1969 182 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-19802

Complete, three-dimensional crystal and molecular structure determinations are reported for four compounds of Mo and Ni bonded to one-electron organic ligands. The structure of (pi-C7H7)Mo(CO)2 C6F5 (I) yields a Mo-C6F5 distance of 2.244(+ or – 0.009)A, indicating significant bond-shortening from the previously determined molybdenum-carbon single-bond distance of 2.383 (+ or – 0.010)A. Subsequent studies on (pi-C5H5)Ni(PPh3)C6F5 (II) and (pi-C5H5)Ni(PPh3)C6H5 (III) show that although the Ni-C6F5 complex (II) is considerably more stable than the non-fluorinated Ni-C6H5 compound (III), this extra stability does not correlate with a significantly shorter (stronger) nickel-carbon bond to the more electro-negative –C6F5 ligand: the Ni-C6F5 and Ni-C6H5 distances are 1.914(+ or – 0.014)A and 1.904(+ or – 0.007)A respectively. An X-ray structure of (pi-C5H5)Ni(PPh3)-CF3 (IV) establishes a Ni-CF3 distance of 1.948(+ or – 0.022)A. Dissert. Abstr.

N70-23860# Rocket Propulsion Establishment, Westcott (England).
COMPOSITE PROPELLENT CATALYSTS: COPPER CHROMATE AND COPPER CHROMITE
G. S. Pearson May 1969 25 p refs
(RPE-TR-6917) Avail: CFSTI

The thermal decomposition of copper chromate and copper chromite were examined by simultaneous thermogravimetric analysis and differential thermal analysis. Decomposition proceeds in successive stages ultimately yielding cuprous chromite and cuprous oxide from both copper chromate and copper chromite. Alternate successive exposure of the catalyst at 400 to 420 C to fuel (ammonia, isobutene or ethylene) and oxygen showed that after the initial reduction, a redox cycle occurred between cupric oxide and copper. Both stages of the redox cycle were associated with exothermic reactions. No redox cycle was observed when methane was used as a fuel. When perchloric acid was used as oxidizer, an irreversible weight change occurred, along with the oxidation part of the redox cycle. The relevance of these results to the mechanism of composite propellent catalysis is discussed. Author (ESRO)

N70-23894# Naval Ordnance Lab., White Oak, Md.
TWO EMPIRICAL CORRESPONDING STATES RELATIONSHIPS FOR THE RATIO OF THE HEAT CAPACITIES OF POLYMERS Interim Report
R. W. Warfield, D. J. Pastine, and M. C. Petree 21 Oct. 1969 19 p refs
(AD-699139; NOLTR-69-98) Avail: CFSTI CSCL 7/4

Two empirical corresponding states relationships between the ratio of the heat capacities C(p)/C(v) and the reduced temperature parameters T/T(g) and T/T(m) have been found. These relationships are discussed in terms of the corresponding states behavior. These relationships are significant and useful in that the ratio C(p)/C(v) is a fundamental constant for a polymer and that a knowledge of the value of this ratio is indispensable for converting adiabatic data into the corresponding isothermal value. Author (TAB)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N70-22520# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRINCIPLES OF JAMMING AND ELECTRONIC RECONNAISSANCE, VOLUME 1
S. A. Vakin et al 23 May 1969 286 p Transl. into ENGLISH of the book "Osnovy Radioprotivodystviya i Radiotekhnicheskoi Razvedki" Moscow, Sovetskoye Radio, 1968 p 1–444
(AD-692642; FTD-MT-24-115-69-Vol-1) Avail: CFSTI CSCL 17/4

The book is the first work in which with the using of contemporary mathematical methods there is systematically expounded the theory of jamming and electronic reconnaissance. Information, power and operational-tactical criteria of the effectiveness of means and methods of the creation of interference are examined. Methods of the estimate of information loss, applied by means of active jamming to radar stations operating in scanning conditions, are described. Different forms of active jamming on the channel of angular tracking of radar (monopulse and with conical scanning) are investigated. Peculiarities of functioning radar systems of automatic tracking in the direction with the action of special interference signals are examined. Methods of the creation of active jamming to systems of automatic range and speed tracking are discussed. An extimate of different forms of interference signals to radio links of communication and command control is given. Calculation relationships are derived which allow estimating the necessary quantity of dipole reflectors for the suppression of radar of different assignment, including and pulse-coherent radar. Principles of the application of radar traps in different links of control system by means of antiaircraft defense are discussed. Author (TAB)

N70-22521# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRINCIPLES OF JAMMING AND ELECTRONIC RECONNAISSANCE, VOLUME 2
S. A. Vakin et al 23 May 1969 224 p refs Transl. into ENGLISH of the book "Osnovy Radioprotivodystviya i Radiotekhnicheskoi Razvedki" Moscow, Sovetskoye Radio, 1968 p 1–444
(AD-692643; FTD-MT-24-115-69-Vol-2) Avail: CFSTI CSCL 17/4

For abstract see N70-22520.

N70-22533# Sylvania Electronic Systems-East, Waltham, Mass. Applied Research Lab.
ALGEBRAIC THEORY OF CODES 2
E. F. Assmus, Jr. and H. F. Mattson, Jr. 15 Oct. 1969 91 p refs *Its* No. Scientific-1
(Contract F19628-69-C-0068)
(AD-698813; S-8199-1; AFCRL-69-0461) Avail: CFSTI CSCL 9/4

Automorphism groups of some 5-designs are determined. The weights in the extended quadratic residue code of length 48 over GF(3), and associated 5-design parameters, are found. The graph arising from another ternary code is analyzed. Connections between decoding and penny-weighing are described, and two decoding methods are set down. Miscellaneous results on covering radii, on a small code with a large automorphism group, on k-th order Steiner systems, and on optimal codes are included. Author (TAB)

N70-22543# Sylvania Electronic Systems-East, Waltham, Mass. Communication Systems Div.

NEW CODES FOR FEEDBACK COMMUNICATION SYSTEMS Final Report, 4 Jan. 1968 – 31 Oct. 1969
J. Pieter, M. Schalkwijk, John H. Meyn, and Mark E. Barron 31 Oct. 1969 120 p refs
(Contract F19628-68-C-0064)
(AD-698818; AFCRL-69-0475) Avail: CFSTI CSCL 9/4

A number of schemes to improve the quality of data transmission over discrete memoryless and Gaussian noise channels by using a feedback channel are presented, compared, and analyzed. It is indicated that linear schemes cannot achieve an arbitrarily small error probability when a peak-power constraint is applied. Variable geometry schemes are introduced as one possible solution to this difficulty. The binary communication schemes of Turin and of Kramer are presented and developed for the case of bandlimited signals and non-zero error probability. The optimization of the energy distribution for each of the two schemes is presented and the effects of a peak-power constraint are derived. Some new mathematical results are presented for the discrete memoryless and Gaussian noise channels. The error exponents for the binary and M-ary symmetric channels with sequential decision feedback are derived and shown to be less than that for sequential information feedback. For the Gaussian white noise channel, the error exponent of the optimum information feedback scheme subject to a peak-power constraint is evaluated. Author (TAB)

N70-22674*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CALCULATION OF SCATTERED PATTERNS FROM ASYMMETRICAL REFLECTORS
Arthur C. Ludwig 15 Feb. 1970 74 p refs
(Contract NAS7-100)
(NASA-CR-109249; JPL-TR-32-1430) Avail: CFSTI CSCL 20/14

A computer program for evaluating the electromagnetic field pattern of a known arbitrary incident field scattered from a perfectly conducting reflector of arbitrary shape is presented. It is shown that the commonly used assumption of far-field behavior for the incident field leads to poor results in some cases; an exact method is developed in which a spherical-wave expansion is used to represent the incident field, and it is shown that this method yields the correct result in these cases. The scattering surface is represented by a Fourier type of expansion in one variable, where the coefficients are specified as tabular functions of the remaining variable. A tilted figure of revolution is a case of practical importance, and it is shown that, for small tilt angles, three Fourier components are usually sufficient to represent the surface. A new nonlinear integration technique is used that is four to eight times faster than Simpson's rule integration, under specified conditions. Other techniques to maximize program efficiency are described. The subreflector and main reflector patterns of an 85-ft-diam Cassegrainian antenna are computed, using both the far-field approximation and a spherical-wave expansion to represent the incident fields. Author

N70-22628# Sandia Corp., Albuquerque, N.Mex.
A PHASE EQUALIZER AND PREDETECTION COMBINER USING FM-TO-PM CONVERSION Development Report
Thurlow W. H. Caffey and William R. Hale Sep. 1969 26 p refs
(PB-187227; SC-DR-69-536) Avail: CFSTI CSCL 09F

The report describes the second model of a phase equalizer and predetection combiner which was built as part of the conversion effort from P-band to S-band and L-band telemetry. USGRDR

N70-22642# RCA International Service Corp., Patrick AFB, Fla.
EFFECTIVENESS OF FEEDFORWARD STABILIZATION
Peter Tokareff, Jr. and Clayton V. Hatley, Jr. Dec. 1969 43 p refs
(Contract F08606-68-C-0040)
(AD-698334; AFETR-TR-69-8) Avail: CFSTI CSCL 17/9

Tracking radars installed aboard instrumentation ships require sophisticated systems of stabilization. Gyros mounted on the tracking radar have been the classical approach to this problem. Recently however, a system known as Feedforward Stabilization has been perfected. The feedforward stabilization can be used separately or as an additional enhancement to gyro stabilization. This paper describes the application of feedforward stabilization to a specific installation (USNS General H. S. Vandenberg) and the quantitative measurement of its effectiveness using unique digital computer programs employing frequency domain processing as well as time domain processing. Author (TAB)

N70-22711# Princeton Univ., N.J. Dept. of Electrical Engineering.
SOME PHYSICAL MODELS FOR NOISE PROCESSES
K. C. Daly and J. B. Thomas Dec. 1969 24 p refs Presented at the Eastern Regional Meeting of the Simulation Councils, Inc., 9 Apr. 1969
(Grant AF-AFOSR-1333-67)
(AD-698841; AFOSR-69-3074TR) Avail: CFSTI CSCL 9/3

Several representations are proposed as models for a large class of naturally occurring noise processes. These models can be studied by both statistical analysis and simple simulation using analog or hybrid equipment. Theoretical and preliminary experimental results are presented and areas for further research are indicated. Author (TAB)

N70-22800# California Univ., Livermore. Lawrence Radiation Lab.
DECONVOLUTION AND COMPENSATION IN THE MEASUREMENT OF BROADBAND SIGNALS
V. R. Algazi and M. P. Ekstrom 27 Oct. 1969 12 p refs
(PB-187896; UCRL-72083) Avail: CFSTI CSCL 09D

The report considers the recovery of broadband non-random signals distorted by the dynamics of the transmission system and corrupted by additive noise. The design and performance of deconvolution and compensation systems for a mean-square performance measure are discussed. After pointing out the deficiencies of deconvolution without compensation, the joint design of the two signal processing schemes under engineering constraints is presented, and illustrated by some examples. Finally the results obtained when the signals are samples of stationary random process with known statistics are briefly discussed. Author (USGRDR)

N70-22808*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-60, VOLUME 2 FOR THE PERIOD 1 SEPTEMBER TO 31 OCTOBER 1969. THE DEEP SPACE NETWORK
30 Nov. 1969 186 p refs
(Contract NAS7-100)
(NASA-CR-109289; JPL-SPS-37-60-Vol-2) Copyright. Avail: CFSTI CSCL 17B

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11. OPERATIONS AND FACILITIES: FACILITY ENGINEERING
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N70-22809*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INTRODUCTION: DESCRIPTION OF THE DSN
In its Space Programs Sum. No. 37-60, Vol. 2 30 Nov. 1969 p 1–3 (See N70-22809 10-07)
Copyright. Avail: CFSTI CSCL 17B

A brief description of the tracking data and the facilities of the Deep Space Network is given. The data types are identified as metric data, telemetry, and command signals. The Deep Space Instrumentation Facility comprises the world-wide set of deep space stations, deep space communications complexes, and the mobile compatibility test facility. The Ground Communications Facility provides voice, high speed data, and teletype communications between the Space Flight Operations Facility and the deep space stations. The Space Flight Operations Facility performs network and mission control functions. N.E.N.

N70-22810*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MISSION SUPPORT: PLANETARY FLIGHT PROJECTS
In its Space Programs Sum. No. 37-60, Vol. 2 30 Nov. 1969 p 4–6 (See N70-22808 10-07)
Copyright. Avail: CFSTI CSCL 17B

The Mariner Mars 1971 mission support activities are outlined. Recent changes are the data processing configuration in the Space Flight Operations Facility and the data flow in the Ground Communications Facility to and from the Deep Space Instrumentation Facility. These changes and their effects on the system are described. Open-loop receivers for support of the S-band occultation experiment and three telemetry and command processor programs are also mentioned. N.E.N.

N70-22811*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ADVANCED ENGINEERING: COMMUNICATIONS SYSTEMS RESEARCH
In its Space Programs Sum. No. 37-60, Vol. 2 30 Nov. 1969 p 7–37 refs (See N70-22808 10-07)
Copyright. Avail: CFSTI CSCL 17B

Digital telemetry and command are discussed. The single-sample maximum likelihood estimate of noise variance in block-coded telemetry is derived. Quantization requirements for data channel quantizers are considered for the multimission telemetry system, and the number of quantization levels is indicated. The optimum modulation index and the maximum possible data rate were determined, and design curves are presented for uncoded and biorthagonal coded signals over the entire range of possible loop signal to noise ratios and data rates. A screening test method was developed for low noise voltage controlled oscillators. The following information systems are also discussed. The operation of a binary-to-symbolic translator for the SDS 900 series is described. A digital video display system was designed for the Venus range-Doppler radar data. Results on scheduling algorithms for single and multiple processors in a hard real time environment are discussed. N.E.N.

N70-22812*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ADVANCED ENGINEERING: COMMUNICATIONS ELEMENTS RESEARCH
In its Space Programs Sum. No. 37-60, Vol. 2 30 Nov. 1969 p 37–45, refs (See N70-22808 10-07)
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Research on improved RF calibration techniques for the Deep Space Network are reported. Data are presented for system-operating noise-temperature calibrations of three S-band research cones; the planetary radar, research operational, and Cassegrain ultra cones. Preliminary results are given of an experimental program to test the validity of an attenuation law and to develop compact S- and X-band rotary vane attenuators for calibration of low noise antenna systems. New noise sources for calibrating system temperature measurements at Deep Space Stations 13 and 14 are described. N.E.N.

N70-22813*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ADVANCED ENGINEERING: SUPPORTING RESEARCH AND TECHNOLOGY
In its Space Programs Sum. No. 37-60, Vol. 2 30 Nov. 1969 p 46–74 refs (See N70-22808 10-07)
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Continuing research activities are reported for the following: simulated engineering telemetry using Mariner Mars 1969 vehicle; modifications to the syntax of transmogrification compiler for telemetry simulation; formalism for telemetry decommutation; comparison of two methods of generating a stationary time series with a prescribed spectral density function; prototype microwave switch controller for the Deep Space Station 14 S-band Cassegrain ultra cone; analysis of an automatic ephemeris update tracking scheme; Deep Space Station 13 radar experiments; and low level interface module and integrated circuit applications for the Hi-Rel digital modules. N.E.N.

N70-22814*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ADVANCED ENGINEERING: TRACKING AND NAVIGATIONAL ACCURACY ANALYSIS
In its Space Programs Sum. No. 37-60, Vol. 2 30 Nov. 1969 p 74–136 refs (See N70-22808 10-07)
Copyright. Avail: CFSTI CSCL 17B

The tracking system analytical calibration activities include ionospheric calibration of radio tracking data, station location solutions and orbit determinations, space plasma effects on Mariner 5 and Pioneer 9 navigation, and an algorithm for calculating the view periods of a distant spacecraft and analysis of its errors. The use of sequential estimation on the orbit determination problem for a planetary orbiter is described. Lunar orbiter and Apollo 10 and 11 data on lunar surface mass distributions and gravimetric measurements are discussed. Analyses are given of lunar libration and Doppler determination of the earth's gravitational constant. The feasibility of computing Doppler observables from differenced-range observables is demonstrated. N.E.N.

N70-22815*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT AND IMPLEMENTATION: DSIF DEVELOPMENT
In its Space Programs Sum. No. 37-60, Vol. 2 30 Nov. 1969 p 137–151 (See N70-22808 10-07)
Copyright. Avail: CFSTI CSCL 17B

Component and system developments for the Deep Space Instrumentation Facility are described. The redesign of field instrumentation for the erection of the antenna-mechnical subsystem is outlined. A damage prevention system is considered for the 85-ft antennas. Ideal and actual phase modulator designs are developed for the Block 3 C S-band receiver/exciter subsystem. A larger control system for the 400 kW transmitter system was built and is being tested. A high-voltage power supply and cooling system was installed at Deep Space Station 14. Monitor system developments and problems association with frequency and timing subsystems are mentioned, along with analog recording flutter sensitivity tests. A control was designed and installed at Deep Space Station 13 for the 1750-hp motor generator. N.E.N.

N70-22816*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT AND IMPLEMENTATION: DSN PROJECTS AND SYSTEMS DEVELOPMENT
In its Space Programs Sum. No. 37-60, Vol. 2 30 Nov. 1969 p 151–169 ref (See N70-22808 10-07)
Copyright. Avail: CFSTI CSCL 17B

Details are given on the system verification test and receiver modifications of the multiple-mission telemetry system project. The operational experience with Mariner Mars 1969 and Pioneer vehicles are discussed, and plans for future Pioneers and Mariner Mars 1971 are mentioned. The installation, calibration, and initial performance of the clock synchronization equipment at four Deep Space Stations are also described. N.E.N.

N70-22817*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OPERATIONS AND FACILITIES: DSN OPERATIONS
In its Space Programs Sum. No. 37-60, Vol. 2 30 Nov. 1969 p 170–173 (See N70-22808 10-07)
Copyright. Avail: CFSTI CSCL 17B

The equipment and method are described which were used to measure the apparent change of angular separation between radio sources 3C273 and 3C279 just before and after the latter was occulted by the sun on 8 October 1969. Deep Space Stations 13 and 14 were configured as elements of a phase-sensitive interferometer, and the configuration is diagrammed. N.E.N.

N70-22818*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OPERATIONS AND FACILITIES: DSIF OPERATIONS
In its Space Programs Sum. No. 37-60, Vol. 2 30 Nov. 1969 p 173–175 ref (See N70-22808 10-07)
Copyright. Avail: CFSTI CSCL 17B

The configuration and analysis of the system used to search the RF spectrum for extraneous and expected frequencies in telecommunications compatibility testing are briefly described. The technique provides S-band receiver voltage-controlled oscillator (VCO) tuning control, frequency monitoring and frequency band power level measurements, and RF spectrum data recorded on the line printer. N.E.N.

N70-22857*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 29–47 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 17B

Globally optimum single standard run lengths of zeros and ones are derived for the binary first-order Markov source and the optimum single standard run length for the binary independent source is then derived as a special case. It is assumed that the output symbols are subsequently block coded in each case. Compression ratio maxima are found by computer search for the binary independent source when the output symbols are subsequently Hoffman coded and sometimes are global optimums. A mathematical assumption is developed for certain probability densities that satisfy Focker-Planck equations for phase-locked loops and other tracking systems. A combinatorial problem is solved in rearrangements of incidence tables by using a distinct representative theorem. Also analyzed is a multiple demand access satellite systems for speech communications in remote areas by evaluating necessary satellite and ground station parameters as well as modulation and multiple access methods. G.G.

N70-22858*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS ELEMENTS RESEARCH
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 48–64 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI

The feasibility of using an optical-acoustical laser system for correlating a received signal against many reference signals and selecting the one which best fits the received signal, is studied. The possibility of achieving real time optical correlation is demonstrated in heuristic model where the diffraction of light by ultrasonic waves is considered in a real time signal processor. Major system limitations seem to arise from capabilities of the transducers. Several spacecraft reflector designs are presented with the common feature that the main reflector is a single curved surface. A zone-plate lens antenna study indicates that this system synthesizes the desired wavefront by rejecting radiation from zones which are out-of-phase components. The fact that the phase is not uniform over in-phase zones results in low efficiency; zone plate gains are limited to a narrow frequency band. Data covering RF voltage breakdown in coaxial lines with impedances higher than 50 ohm established little advantage in the use of higher impedance lines. G.G.

N70-22859*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT TELEMETRY
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 65–70 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 09F

A computer accessed telemetry system that utilizes nested DO loops in the computer is evaluated for its advantages over the current Mariner telemetry system. It is shown that this approach provides a flexible interface between spacecraft systems and both, the onboard and ground based commands. Also described are digital command concepts for the remote control of spacecraft that will operate at pulse-code-modulated bit rates from 4 to 64 bit/s, at a normalized signal-to-noise ratio of 10 dB, and with bit and acquisition rate error rates of less than 0.00001. G.G.

N70-22861*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT COMMUNICATION SYSTEMS
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 78–89 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 17B

Proposed is a fast two-dimensional Fourier analysis that uses decimation in the two-dimensional sample domain of the largest matrix whose transform can be found without multiplication. The application of rank coding in telemetry systems is considered and the probability of error in such a system is determined experimentally for various noise conditions. Results show that coding may be used to improve both the information rate and the probability of error, and that an increase in the number of samples per signal always results in improved performance. The best code discovered was that with $n = 6$ and $m = 6$. G.G.

N70-22910*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMMUNICATIONS AND DATA SYSTEMS
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 36 p (See N70-22901 10-31)
Avail: CFSTI CSCL 17B

Requirements are considered for on-board data handling, data storage, antenna system, transmitters, and the command system of the satellite. The various components of the communications and data systems are described in detail. Recommendations are made for modifying data storage and dump to accommodate STADAN capabilities. R.B.

N70-22922*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMMUNICATIONS AND DATA SYSTEMS, APPENDIX I
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 14 p (See N70-22901 10-31)
Avail: CFSTI CSCL 17B

Several communication and data system configurations are reviewed that were considered in a previous study and reasons are given for eliminating them from the baseline system design. Author

N70-22948# AEG-Telefunken, Ulm (West Germany).
DEVELOPMENT OF AN ONBOARD TRANSMITTER/RECEIVER USING MODULAR TECHNIQUES [ENTWICKLUNG EINES BOARD-SENDER-EMPFAENGERS IN BAUSTEINTECHNIK]
Th. Radke, E. O. Schmitz, and G. Weber Oct. 1969 133 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin.

Fuer Wiss. Forsch.
(BMWF-FB-W-69-42) Avail: CFSTI

The consequences of changing frequencies for telemetry and command signals to the L-band and S-band are considered. The development of a telemetry transmitter for 400 MHz and a command receiver for 450 MHz, built on modular design principles, is described. Laboratory models were subjected to initial tests. The possibility of making the modular system usable for the L-band and S-band telemetry frequencies is discussed. Author (ESRO)

N70-22993# Standard Electrik Lorenz A. G., Stuttgart (West Germany). Lab. WNS/LNB.
DEVELOPMENT, DESIGN AND TESTING OF TELEMETRY AND COMMAND SYSTEM EQUIPMENT OF A COMMUNICATIONS SATELLITE [FORTFUEHRUNG DER ENTWICKLUNG SOWIE BAU UND PRUEFUNG VON BORDGERAETEN DES TELEMETRIE- UND KOMMANDOSYSTEMS EINES NACHRICHTENSATELLITEN]
H. Kallerhoff, H. Valdorf, and D. Schaffar Sep. 1969 117 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-69-39) Avail: CFSTI

The laboratory models for a command receiver, a PCM-PM telemetry encorder, PM transmitter, and a diplexer were subjected to electrical and environmental tests. The tests results show that the equipment is suitable for use in communication satellites. Multiplexers with field effect transistors and analog to digital converters with integrated circuits were investigated. Author (ESRO)

N70-23112# Advisory Group for Aerospace Research and Development, Paris (France).
IONOSPHERIC FORECASTING
Vaughn Agy (ESSA, Boulder, Colo.), ed. Jan. 1970 472 p refs Presented at the Avionics Panel 15th Tech. Symp., Quebec, 2–5 Sep. 1969
(AGARD-CP-49) Avail: CFSTI

Discussed are current forecasting systems and their relation to forecast requirements. Ionospheric forecasting techniques are outlined and the effects of solar-geophysical events on the ionosphere are described. For detailed individual titles see: N70-23113 through N70-23151.

N70-23114# Environmental Science Services Administration, Boulder, Colo. Aeronomy and Space Data Center.
IONOSPHERIC FORECASTING IN THE UNITED STATES, 1942–1966
J. Virginia Lincoln *In* AGARD Ionospheric Forecasting Jan. 1970 8 p refs (See N70-23112 10-07)
Avail: CFSTI

Short-term ionospheric forecasting began in 1942 at the Interservice Radio Propagation Laboratory of the National Bureau of Standards. The techniques used and their development in the Western Hemisphere will be discussed up to the beginning of the computer-oriented types of forecasts. Author

N70-23116# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
OPERATIONALLY ORIENTED TELECOMMUNICATION FORECAST SERVICE
Roger K. Salaman *In* AGARD Ionospheric Forecasting Jan. 1970 15 p refs (See N70-23112 10-07)
Avail: CFSTI

Systems to forecast solar-geophysical events and the resultant propagation interactions have been in operation for many years. The purpose of this paper is to stimulate development of forecasting systems which are oriented more to the needs of the telecommunication system operators. Although the specific application referenced here is HF communications, the concepts are applicable to systems working in other areas of the radio spectrum. Author

N70-23125# Sheffield Univ. (England). Dept. of Physics.
THE MORPHOLOGY OF HIGH LATITUDE VLF EMISSIONS
A. R. W. Hughes, K. Bullough, and T. R. Kaiser *In* AGARD Ionospheric Forecasting Jan. 1970 11 p refs (See N70-23112 10-07)
Avail: CFSTI

The VLF experiment on the satellite Ariel III was designed to make a synoptic study of VLF phenomena above the ionosphere. The peak, mean and minimum signals at 3.2, 9.6 and 16 kHz are measured in each 28 second period around the orbit. On-board tape-recording of this data and the high sensitivity and wide dynamic range of the receiver make it possible to delineate a zone of emission above the auroral oval in both hemispheres at all magnetic local times. This analysis is restricted to the period 1967 May, June, July. The locations of the zones of emission and associated particle precipitation in the north and south polar regions are related to the tilt of the earth's rotational axis towards the sun in the northern hemisphere summer. The zone maximum is displaced to lower invariant latitudes with increasing magnetic disturbance, the displacement being greatest at local noon and least at local midnight. Author

N70-23126# Stanford Research Inst., Menlo Park, Calif.
USE OF BACKSCATTER MEASUREMENTS TO IMPROVE HF COMMUNICATION PREDICTIONS
R. R. Bartholomew *In* AGARD Ionospheric Forecasting Jan. 1970 6 p refs (See N70-23112 10-07)
Avail: CFSTI

A comparison of MUF's predicted computer program with observations on three paths in the northern hemisphere demonstrates the need for better prediction methods. Past studies have shown that the MUF for a communication path can be predicted by using backscatter soundings. It is now possible to generate three-dimensional maps of ionospheric parameters from measurements of the remote ionosphere made by using backscatter sounding techniques. Examples of maps of penetration frequency, layer height, and skip distance are presented. Use of a map generated from a single backscatter sounding station to predict the MUF's for a number of differently oriented communication paths is explained. Author

N70-23127# Stanford Research Inst., Menlo Park, Calif.
SIGNAL PROCESSING TECHNIQUES FOR BACKSCATTER IONOGRAMS
H. N. Shaver *In* AGARD Ionospheric Forecasting Jan. 1970 14 p refs (See N70-23112 10-07)
Avail: CFSTI

The usefulness of ground backscatter returns for estimating existing ionospheric parameters at a distance has provided the impetus for an investigation of appropriate techniques for ionogram processing. Signal processing techniques for estimating desired parameters from digitally recorded sweep-frequency backscatter returns are considered. The techniques presented include the currently used time-domain processing and alternative techniques based on frequency-domain processing. Results obtained by using various techniques are compared. System implementations of the techniques for nearly real-time processing are described and discussed. Author

N70-23128# Stanford Research Inst., Menlo Park, Calif.
DERIVATION OF IONOSPHERIC PARAMETERS FROM BACKSCATTER DATA
V. E. Hatfield *In* AGARD Ionospheric Forecasting Jan. 1970 11 p refs (See N70-23112 10-07)
Avail: CFSTI

A computer program has been developed to transform backscatter data into an ionospheric map. To construct such a map, ionograms recorded from nine narrow-beam antennas over an azimuthal range of 108 deg were used. From the ionograms, time delay and amplitude as a function of frequency were derived and translated into ionospheric parameters. These parameters were

related directly to the minimum time-delay pulse by using theoretical equations. By assuming a "quasi-parabolic" model, the corresponding ray equations may be used. The parameters, the height of the bottom of the layer, the layer semi-thickness, and the critical frequency, may be varied to arrive at a solution of the minimum time-delay equation. It was found possible to fix two of these parameters and solve for the third. For the fixed parameters, vertical-incidence parameters directly overhead were used; the third parameter was generated from the backscatter trace. To obtain the overhead parameters, a new program was generated to extract them from the vertical-incidence portion of the backscatter ionogram. A satisfactory technique for deriving these parameters was developed. Contour maps were made from critical frequency as a function of range and azimuth, using a polynominal fit. Representative maps are presented. Author

N70-23129# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
IONOSPHERIC MAPPING BY BACKSCATTER
J. C. Blair, R. D. Hunsucker, and L. H. Tveten *In* AGARD Ionospheric Forecasting Jan. 1970 12 p refs (See N70-23112 10-07)
Avail: CFSTI

Recent ionospheric mapping results obtained using a narrow-beam HF scan radar at the Institute for Telecommunication Sciences of the ESSA Research Laboratories at Boulder, Colorado are presented. These include skip distance contour maps at several different frequencies for a midlatitude location. Also given is a technique for obtaining ionospheric plasma frequency as a function of virtual height values from remote backscatter measurements. This technique yielded a 5 percent mean algebraic error and a standard deviation of 11 percent when compared to vertical ionosonde data during nondisturbed periods. Using HF Doppler backscatter and spectral separation techniques, ground features such as coastlines may also be mapped. Author

N70-23130# Avco Corp., Lowell, Mass. Systems Div.
HF-RTW PROPAGATION STUDY: PREDICTION SCHEME AND SYNOPTIC BEHAVIOUR
C. A. Moo *In* AGARD Ionospheric Forecasting Jan. 1970 10 p refs (See N70-23112 10-07)
(Contracts AF 30(602)-3895; F30602-67-C-0016)
Avail: CFSTI

Results of a year's observations of the amplitude variations of pulsed-CW around-the-world (RTW) transmissions on selected frequencies from Manila at 320 deg azimuth are described. For scheduling monitoring time and frequencies, a prediction scheme based on the RTW propagation model of Fenwick (1963), was developed. The model involves earth-ionosphere reflections in the daylight hemisphere and ionosphere–ionosphere reflections in the dark hemisphere, with propagation possible when the transmitter is in the daylight. Using ESSA world maps of MUF (4000 km) F2, along the great-circle path, the scheme selected as the RTW MUF at a given time the lesser of the following quantities: the least MUF (4000) F2 value in the dayside (multihop MUF), and twice the least MUF (4000) F2 value in the nightside (ionosphere–ionosphere MUF, Grossi and Langworthy (1966). Amplitude measurements were made by range sampling the RTW-delayed echoes during half-minute pulsing periods every half hour, on several frequencies. The diurnal variation of signal amplitudes establishes the key role of sunrise and sunset tilts in RTW propagation, and validates the propagation mode. The maximum frequencies observed were consistently above the predicted MUFs, the latter corresponding more nearly to the frequencies for optimum RTW signal levels. The disparity between predicted and observed MUFs may reflect the well known limits of the MUF maps employed in the predictions. Author

N70-23132# Forschungsinstitut fuer Hochfrequenzphysik, Bonn (West Germany). Dept. of Telecommunications.
MONITORING MULTI-FREQUENCY MODE DELAY OVER LONG DISTANCES FOR IONOSPHERIC FREQUENCY SELECTION
H. J. Albrecht *In* AGARD Ionospheric Forecasting Jan. 1970 refs 12 p (See N70-23112 10-07)
Avail: CFSTI

With particular reference to those ionospheric predictions requiring a large short-term accuracy, purely statistical methods, such as CURTS and similar systems, exist alongside with those considering at least some ionospheric parameters. These systems generally analyse the trend indicated by ionospheric parameters and use the result in calculation procedures. This paper describes a method of monitoring mode delay along the path of interest with the use of transmissions at one end on several frequencies in the HF-range. Mode delay measurements are simultaneously carried out on all frequencies. A comparison of such data with the average long term behaviour of the path then indicates the trend of short-term characteristics along the ionospheric path. Methods of path analysis such as path diagrams, ground effects, etc. may then be employed similar to those described by the author several years ago. The method as a whole renders itself to all applications of modern short-term predictions and automatic selection of optimum operating frequencies. In addition, it is far more inexpensive than a complete oblique-incidence sounding system. Author

N70-23133# Granger Associates, Palo Alto, Calif.
SHORT-TERM PREDICTION OF HF COMMUNICATION CIRCUIT PERFORMANCE
J. W. Ames, R. D. Egan, and G. F. Mac Ginitie *In* AGARD Ionospheric Forecasting Jan. 1970 refs 12 p (See N70-23112 10-07)
Avail: CFSTI

Short-term prediction of oblique ionospheric HF communication circuit optimum working frequency and quality can materially aid frequency management and reduce spectrum congestion. Real-time prediction of these quantities has been implemented with a small digital processor. Ionosphere support and multipath up to 80 minutes in the future are estimated using a linear prediction process based on oblique sounder measurements. The means, variances, and covariances of the variables necessary to the prediction process are stored as Fourier coefficients of diurnal variation. This provdes smoothing of the random fluctuations between measurements for adjacent periods, and in addition saves storage space relative to the alternative of storing averages for each prediction increment. The coefficients themselves are updated in a manner similar to the formation of running averages. The processor accepts either analog (video), or digital data from up to 15 sounder paths. Provision is also made for accepting measured interference or noise from selected communication frequencies to provide a direct estimate of signal-to-noise ratio. The ionosphere forecasts are combined with the signal-to-noise ratio to rank the assigned frequencies in order of expected utility during the prediction period. Author

N70-23134# Leicester Univ. (England). Dept. of Physics.
VARIATION OF IONOSPHERIC ABSORPTION AT WIDELY SPACED STATIONS
T. B. Jones and W. Keenliside *In* AGARD Ionospheric Forecasting Jan. 1970 refs 9 p (See N70-23112 10-07)
Avail: CFSTI

The possibility of predicting ionospheric absorption changes on one propagation path from measurements made on another is discussed. Vertical and oblique incidence absorption measurements are available for a number of European stations and these have been examined for similarities in absorption variations for the period January–December 1966. During the equinox and winter seasons the absorption changes were found to be well correlated for paths with mid point separations of less than 600 km, although the degree of correlation decreases with increasing separation. In summer the correlation is not as clearly defined and for path mid point separation of more than 300 km, the correlation is not significant. Author

N70-23135# Fernmeldetechnisches Zentralamt, Darmstadt (West Germany).
POSITIVE PHASES AND DISTURBANCES OF THE IONOSPHERIC WAVE PROPAGATION IN COMPARISON WITH SOLAR-TERRESTRIAL EVENTS
B. Beckmann *In* AGARD Ionospheric Forecasting Jan. 1970 refs 27 p (See N70-23112 10-07)
Avail: CFSTI

Ionospheric observations can be evaluated for forecasting by means of an extrapolation in time and the following average results regarding the nature of solar-terrestrial relations can be obtained: (1) the frequency probability of local drops of the night-time critical frequency of the F-layer in mid-latitudes reaches up to 20% and varies with the geomagnetic activity; (2) positive phases may be followed by a decrease in the above-normal range of the propagation quality; (3) if, simultaneously, the flux of the solar 10 cm-radiation changes in that it either rises or declines steadily while there is a strong increase in the flare activity, a world-wide radio disturbance can be expected to follow after 3 or 4 days; (4) the upward tendency of the cosmic ray intensity occurring due to eruptive centres on the eastern side of the sun will be weakened if these centres are situated in the central zone or on the western side; (5) during the disturbance the Forbush effect is often found to be accompanied by an increase in the ionospheric absorption; and (6) superimposed epochs from 30 solar rotations (1965 – 1967) of the ionospheric propagation quality, the geomagnetic activity and the cosmic ray intensity indicated a relatively rigid course which was probably attributable to the interplanetary magnetic field of the sun. Author

N70-23136# Weather Wing (4th), Ent AFB, Colo.
USAF SOLAR FORECAST FACILITY IONOSPHERIC SERVICES
T. D. Damon *In* AGARD Ionospheric Forecasting Jan. 1970 refs 6 p (See N70-23112 10-07)
Avail: CFSTI

Ionospheric services provided by the USAF Solar Forecast Center include rapid alerting of the onset of sudden ionospheric disturbances, and daily predictions of MUF and LUF for specific paths. Modern military communications systems allow rapid alerting of the onset of ionospheric disturbances, such as SWF, before the end of the disturbance, thus providing operationally useful information to the communicators. MUF and LUF forecasts are daily modifications of climatological predictions. A group develops and improves forecasting techniques in response to military requirements. Efforts are being made to obtain more real-time sounder observations for use in day-to-day forecasting. Author

N70-23137# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
ADVANCED TELECOMMUNICATION FORECASTING TECHNIQUE
G. H. Stonehocker *In* AGARD Ionospheric Forecasting Jan. 1970 refs 14 p (See N70-23112 10-07)
Avail: CFSTI

Methods of evaluation of solar-geophysical data for objective, rather than subjective, short-term forecasting of ionospheric radio propagation have been assembled into a flexible system for computer application. Solar flare and solar radio noise burst data, with other solar-geophysical information, are used to forecast estimates of expected probability of occurrence, start time, end time and intensity of SWF-SID, PCA and geomagnetic (ionospheric) storms. Using these forecasts together with current observations of pertinent phenomena, hourly changes of attenuation and MUF are predicted for any location and any HF telecommunication circuit. Author

N70-23143# Weapons Research Establishment, Adelaide (Australia).
IONOSPHERIC FORECASTING: RELATED RESEARCH CURRENTLY UNDERTAKEN AT WEAPONS RESEARCH ESTABLISHMENT, SOUTH AUSTRALIA
R. F. Treharne *In* AGARD Ionospheric Forecasting Jan. 1970 90 p refs (See N70-23112 10-07)
Avail: CFSTI

A brief survey is made of research related to ionospheric forecasting currently undertaken. This research includes the comparison of the field strength of separate modes of propagation observed over a 1900 km path with a theoretical prediction program. Including defocussing effects, the measurement of the distant equivalent vertical ionogram by ground backscatter techniques involving vertical triangulation, the prediction of ionograms, and the prediction of anomalous transequatorial radio wave propagation. Author

N70-23144# Syracuse Univ. Research Corp., N.Y.
THE VALUE OF IONOSPHERIC PREDICTIONS
N. C. Gerson *In* AGARD Ionospheric Forecasting Jan. 1970 13 p (See N70-23112 10-07)
Avail: CFSTI

Insofar as the MUF program ITS 1968 is concerned its greatest asset seems to be its advertised computational convenience. As written it represents an unrefined program wasteful of computer time and memory. When employed it offers no assurance that the results obtained are the best possible or the cheapest for the effort involved. It contains a number of inherent deficiencies over and above those organic to the program. The predicted absorption seems too high particularly at the lower frequencies. Noise magnitudes are based upon the assumption of homogeneous isotropic noise distributions within arbitrarily defined geographic zones. Within the U.S. a fair number of groups now run obstensibly the same ITS 1968 program for overlapping purposes in order to obtain precisely computed but inaccurate predictions. The need for continuing duplicative efforts seeking similar approximate predictions seems questionable. If predictions are required it is suggested they be obtained from one large national computational facility specifically designed for this purpose. Until costs are competitive present users will maintain their own prediction units. Author

N70-23145# Canadian Forces Headquarters, Ottawa (Ontario).
APPLICATION OF SHORT TERM PROPAGATION PREDICTIONS AND RADIO DISTURBANCE WARNINGS WITHIN THE CANADIAN FORCES COMMUNICATION SYSTEM
D. A. Reynolds *In* AGARD Ionospheric Forecasting Jan. 1970 9 p (See N70-23112 10-07)
Avail: CFSTI

The Canadian Force Communication System (CFCS) is responsible for the operation and maintenance of strategic communications to serve the needs of the Canadian Armed Forces. This paper outlines the utilization of ionospheric information by communicators within CFCS and presents practical examples of the effects of ionospheric disturbances on actual HF radio circuits. Author

N70-23146# Air Transport Command Headquarters, Trenton (Ontario).
DISCUSSION OF OPERATIONAL FORECASTING PROBLEMS AND REQUIREMENTS OF THE CANADIAN FORCES AIR TRANSPORT COMMAND
R. P. Hypher *In* AGARD Ionospheric Forecasting Jan. 1970 14 p refs (See N70-23112 10-07)
Avail: CFSTI

Long range communications carried out by either the pilot or radio officer in Canadian military aircraft are demanding from a time point of view because of the competing requirements of civil air control, weather forecasting and military command and control. Depending upon the area of operation, the reliability of HF communications will vary sufficiently to present a problem either in attempting to maintain flight safety or to meet the requirements

of the military centralized control. Accurate forecasting on a reasonably short time basis would abviate the requirement for radio operators (and especially pilots) to waste much time in searching through the frequency spectrum. Problems of incompatibility also arise through the predicted best frequency and frequencies allocated by international agreement. This paper will discuss also some of the associated environmental problems that have arisen in operational research studies. Author

N70-23147# Defense Communications Agency, Washington, D.C.
COMMENTS ON THE NATURE OF HF IONOSPHERIC PREDICTIONS REQUIRED FOR USE IN THE DCA AND THE DCS
Samuel E. Probst *In* AGARD Ionospheric Forecasting Jan. 1970 4 p (See N70-23112 10-07)
Avail: CFSTI

Outlined are ionospheric radio propagation prediction methods required by the high frequency network of the Defense Communications Agency. A need is established for three different levels of information on the phenomena of high frequency radio wave propagation that constitutes: (1) computerized prediction methods for use in system planning and analysis of system performance; (2) short term forecasts of propagation disturbances for use by radio system operators and area or regional system controllers; and (3) remote teletype terminals for post analyses and staff briefings on system performance analyses and to provide information on observed properties of propagation disturbances. G.G.

N70-23148# Fernmeldetechnisches Zentralamt, Darmstadt (West Germany).
SHORT-TERM FORECASTING IN GERMANY
B. Beckmann *In* AGARD Ionospheric Forecasting Jan. 1970 refs 11 p (See N70-23112 10-07)
Avail: CFSTI

Short term forecasting began in Germany around 1940. Later in 1942 an independent board was formed with the name "Zentralstelle fur Funkberatung" near Vienna. After 1945 this organization was one of the main bases of the later Max-Planck-Institute for Ionospheric Physics. The main task of this institute was ionospheric research. Therefore the regular preparation of forecasts was discontinued. A smaller part of the "Zentralstelle fur Funkberatung" was separated after 1945 and, in cooperation with the French Forces, organized the Service de Previsions Ionospherique Militaire (SPIM). The group of the German P.T.T. was reorganized within the Fernmeldetechnisches Zentralamt (FTZ) at Darmstadt and resumed its prediction and forecasting work in 1950. Author

N70-23149# Naval Electronics Lab. Center for Command Control and Communications, San Diego, Calif.
IONOSPHERIC FORECAST REQUIREMENTS OF THE OMEGA NAVIGATION SYSTEM
V. R. Noonkester and E. R. Swanson *In* AGARD Ionospheric Forecasting Jan. 1970 9 p refs (See N70-23112 10-07)
Avail: CFSTI

The Omega navigation system which will be implemented by the early 1970's is expected to have a root-mean-square position error of about one nautical mile. This small error can be attained if good skywave corrections and good forecasts of solar and ionospheric activity are available. Reliable sunspot number forecasts will be needed at least one year ahead because the sunspot number is used to compute the skywave corrections which require about one year for computation, printing, and distribution. Thus, poor estimates of sunspot number create position errors which persist for the life of the associated skywave correction tables. Reliable forecasts of SID's and PCA's are needed so that Omega navigators can be warned of expected poor navigation conditions. SID and PCA forecasts must be made at least one day ahead so that they can be distributed by radio messages. These Omega forecast requirements are discussed relative to application and user response. Author

N70-23150# Marconi Co., Ltd., Great Baddow (England). Research Labs.
A MANUAL IONOSPHERIC PREDICTION METHOD USED FOR SYSTEM PLANNING
L. W. Barclay *In* AGARD Ionospheric Forecasting Jan. 1970 refs 9 p (See N70-23112 10-07)
Avail: CFSTI

Ionospheric predictions are prepared primarily for communications system planning to meet customers' requirements. For this purpose both frequency and signal-to-noise ratio predictions are required at extreme ionospheric conditions. Frequencies are now predicted using the C.C.I.R. Atlas, Report 340. Signal field strengths on selected frequencies are predicted by Piggott's technique and are then referred to the noise field strengths from C.C.I.R. Report 322 to give signal-to-noise rations. This way of showing the expected service is more useful for circuit planning purposes than methods which indicate the LUF. Author

N70-23251*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEASUREMENT AND ANALYSIS OF RADIOFREQUENCY INDIGENOUS NOISE
G. Anzic [1970] 20 p refs
(NASA-TM-X-52764) Avail: CFSTI CSCL 17B

Two surveys of radiofrequency noise in two urban areas are presented. A limited survey of rf noise in the greater Cleveland, Ohio area was undertaken during the summer and winter of 1967. The noise measurements were made at 480 and 950 megahertz. Although many sources contribute to the overall rf noise environment, the principal source was found to be automobile ignition. A combined aerial and ground rf noise survey was conducted in Phoenix, Arizona during the summer of 1968. The air and ground measurement systems was essentially the same. Noise measurements were made at 0.3, 1, and 3 gigahertz clear channels with a bandwidth of 2.7 MHz. Author

N70-23270# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
DATA COMPRESSION: A BIBLIOGRAPHY ON SELECTED PRACTICAL METHODS [NACHRICHTENREDUKTION: LITERATURBERICHT UEBER AUSGEWAEHLTE PRAKTISCHE VERFAHREN]
Reiner Lippmann Dec. 1968 112 p refs In GERMAN; ENGLISH summary
(DLR-MITT-68-01) Avail: CFSTI

The concept of data compression is explained and illustrated by means of some characteristic compression methods and aperture techniques, employing polynomial extrapolation or interpolation for eliminating redundant samples. Results of compression effectiveness, using real or synthetic data, are described. In addition, some aspects of addressing and buffering are considered, and some examples of such data compressing are listed. A list of 400 reports is also included. Author (ESRO)

N70-23381*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
CODES FOR PROTECTION FROM SYNCHRONIZATION LOSS AND ADDITIVE ERRORS
G. R. Redinbo and P. A. Wintz Nov. 1969 122 p refs
(Grant NGR-15-005-087; Contract N00014-67-A-0226)
(NASA-CR-109350; TR-EE-69-43) Avail: CFSTI CSCL 09D

Cyclic codes with symbols from a general finite field are modified so that they are also capable of protecting against misframing at the decoder. These codes are modified by altering their distance structure. Results for each modification approach are

given for three types of protection from the simultaneous occurrence of additive errors and synchronization errors. The first type is the detection of some kind of error, the second is the detection and the classification of the nature of the error, and the third is the correction of both kinds of errors. For each approach results are presented for the cases of symmetrical and unsymmetrical ranges of synchronization errors. The proofs of all results indicate the general strategy for decoding the modified code. Author

N70-23419# Joint Publications Research Service, Washington, D.C.
PHOTOELECTRIC TRACKING SYSTEMS
P. V. Nikolayev et al 4 Mar. 1970 167 p refs Transl. into ENGLISH of the book "Fotelektricheskiye Sledyashchiye Sistemy" Moscow, Gosenergoizdat, 1969 p 1-136
(JPRS-49973) Avail: CFSTI

Photoelectric tracking systems technology is reviewed and descriptions are given of photoelectric amplifiers, photoresistances, photodiodes and phototriode devices. The measuring devices of the photoelectric tracking system considered are: a solar photosensor, a half disc modulator of light flux, an analyzing optical device, a slit measuring device of the tuning fork type, a measuring device for a phototracing system of a scale gas cutting automatic machine, and a phototracing system operating on black and white drawings. Components modified for photoelectric tracking systems are examined. These include preamplifiers, error signal amplifiers, modulators, demodulators, and automatic amplification control circuits. Calculations on photoelectric tracking systems are also described. S.S.

N70-23427*# Stanford Research Inst., Menlo Park, Calif. Transportation and Logistics Dept.
A STUDY OF TRENDS IN THE DEMAND FOR INFORMATION TRANSFER Final Report
R. W. Hough, Carolyn Fratessa, Virginia Holley, A. H. Samuel, and L. J. Wells Feb. 1970 137 p refs
(Contract NAS2-5369; SRI Proj. MU-7866)
(NASA-CR-73426) Avail: CFSTI CSCL 17B

The demand trend analysis is presented for the United States, 1970 to 1990. The method used is one of identifying potential as well as present-day services, classifying them into major categories, then establishing quantitative estimates of message traffic occurring within a given time period. In order to aggregate diverse services such as voice, video, and record and data transmission, traffic estimates are converted to the common denominator of bits. These are then summed to provide a composite picture of potential requirements for the future. The major findings concern the maximum amount of electrical or electronic information transfer that might reasonably be expected in the following categories: voice; video; record, data, and private wire; and written (books, magazines, periodicals, newspapers, and mail). Particularly relevant features include the fact that both video and record-and-data transmission are growing considerably faster than voice communications. The amount of information transfer represented by voice communications may be expected to exceed that in all other categories by a considerable margin. Author

N70-23440# Naval Research Lab., Washington, D.C.
DIGITAL RECEIVER DECISION TECHNIQUES FOR CERTAIN FIXED LENGTH BINARY BLOCK CODES TRANSMITTED THROUGH THE GAUSSIAN CHANNEL
Noel C. Balthasar and Hugo M. Beck 20 Nov. 1969 35 p refs
(AD-698283; NRL-7014) Avail: CFSTI CSCL 9/4

Various types of fixed length binary block encodings of binary data are presented. Binary signaling is used to transmit the binary encoded data through an additive white gaussian noise channel. Certain block decision techniques are investigated and compared. For certain block encoding schemes, the notion of an intelligent receiver is developed. The study is considered basic in analyzing the use of redundant encoding in digital communications systems. Author (TAB)

N70-23484# Naval Research Lab., Washington, D.C.
COMPUTER SIMULATION OF STRUCTURAL DETAILS OF HIGH-FREQUENCY OVER-THE-HORIZON EARTH BACKSCATTER
E. L. Althouse, J. R. Davis, and P. E. V. Shannon 24 Nov. 1969 44 p refs
(AD-698280; NRL-6960) Avail: CFSTI CSCL 17/9

A computer program was developed which simulates high-frequency radar backscatter profiles (giving the amplitude as a function of time delay) from previously computed ray trajectories. The ray trajectories were computed from two different ray-tracing programs; both programs use tabular input descriptions of the antenna pattern and ionospheric electron density profile. One ray-trace program, is a two-dimensional program which generates refraction of the ray trajectories in the ionosphere by applying Snells law at the boundary of each incremental slab in a uniformly spherically stratified, earth-concentric ionosphere with changing index of refraction. The second, generates the ray trajectories by performing a three-dimensional, error-checking numerical integration of the six differential Haselgrove equations. The backscatter profiles which result from the ray trajectories in conjunction with the backscatter synthesis program were compared to actual measured profiles for three cases. An analysis was performed for two different model ionospheric electron density profiles to assess the effects of antenna pattern and D-layer absorption on the backscatter profile. Author (TAB)

N70-23488# Department of Agriculture, Washington, D.C. Rural Electrification Administration.
A CHALLENGE AND A BLUEPRINT FOR A TOTAL TELECOMMUNICATIONS SYSTEM
Claude F. Buster, Jr. 1969 17 p Presented at the 18th Intern. Wire and Cable Symp., Atlantic City, 3-5 Dec. 1969
(AD-698599) Avail: CFSTI CSCL 17/2

The article discusses an all-electronic coaxial cable system that will provide total telecommunications services. TAB

N70-23530# Jerrold Electronics Corp., Philadelphia, Pa.
A GRAPHICAL METHOD FOR RELATING COAXIAL CABLE ATTENUATION MEASUREMENTS TO THEORY
Kenneth A. Simons 1968 16 p refs
(AD-698601) Avail: CFSTI CSCL 9/1

A procedure is described for using a set of accurate measurements of cable attenuation versus frequency to derive, by graphical means, the constants in an analytic expression. For cables having solid outer conductors (as contrasted with those having braided shields) the resulting equation accurately relates attenuation and frequency over a wide frequency range and separates the effects of conductor loss and dielectric loss. By comparing the constants with those computed from the dimensions of the cable, the conductor average resistivity and dielectric average power factor can then be found. An example is given showing the use of this technique to study the variation of resistivity and power factor with temperature in two reels of cable. Author (TAB)

N70-23537# GT and E Service Corp., New York
CONCEPTS FOR CABLE TRANSMISSION SYSTEMS
John O. Norback 1969 28 p refs Presented at the 18th Intern. Wire and Cable Symp., Atlantic City, 3-5 Dec. 1969
(AD-698602) Avail: CFSTI CSCL 17/2

It was shown that bi-directional transmission can greatly facilitate the expansion of cable television systems into newer services. The selection of these new services, to be provided over the coaxial cable facility, will be left up to system designers since each of them has its own economics and the most optimum technical solution. Existing cable television systems must be evaluated from the standpoint of market potential for the new services, and

it must be determined if it will be practical and economical to re-adapt the one-way system to bi-directional operation. The type of bi-directional operation, i.e., one-cable or two-cable operation, must also be determined. Author (TAB)

N70-23540*# National Academy of Sciences-National Research Council, Washington, D.C. Div. of Engineering.
USEFUL APPLICATIONS OF EARTH-ORIENTED SATELLITES: SYSTEMS FOR REMOTE-SENSING INFORMATION AND DISTRIBUTION, PANEL 8
Arthur G. Anderson (IMB, Yorktown Heights, N.Y.), Marvin S. Cohen (RCA, Princeton, N.J.), Sidney M. Foulks (Mobile Oil Corp., Dallas, Tex.), Harwood Kolsky (IBM, Palo Alto, Calif.), George J. Zissis (Michigan Univ., Ann Arbor) et al 1969 99 p refs
(Contract NSR-09-012-909)
(NASA-CR-109352) Avail: CFSTI CSCL 17B

The problems and potential for the use of data gathered by remote-sensing or distributed collection devices with collection from satellite or aircraft are considered. The considerations included the collection, processing, storage, and distribution of these data in both processed and raw form. In general, the problems considered focused primarily on those data processing aspects of the total system that lie between the receiving ground station and the user. Inevitably, however, broader judgments were reached on overall systems aspects, partly because of the need for mission planning and control in the data processing system, partly because of the inevitable need to designate operational priorities for the collection and dissemination of data. Author

N70-23560# Aztec School of Languages, Inc., Maynard, Mass.
REVIEW AND APPLICATION OF STATIC SYSTEMS IN LARGE PARABOLIC ANTENNAS [BEHANDLUNG UND ANWENDUNG STATISCHER SYSTEME BEI PARABOLISCHEN GROSSANTENNAN]
Winfried Schoenbach Jan. 1970 74 p refs Transl. into ENGLISH from M. A. N. Forschongsh., no. 14, 1968/69 p 1–37 Prepared for Lincoln Lab., MIT
(AZT-70-638-GELL) Avail: CFSTI

The first part deals with the conventional deflection calculation method formerly used on large parabolic reflector antennas. With the help of examples referring to instruments in operation, an account is given of the approximations that were introduced to keep the calculation operations for determining the static system within reasonable bounds. The use of the electronic deflection calculation proved most advantageous, especially as it yielded a complete deflection pattern of the parabolic reflector. This point is examined in greater detail in connection with a study for a radio telescope of 80 m reflector diameter. The surface accuracies are referred to best-fit paraboloids and due allowance is made for their characteristics in the design of the antenna control. Finally, a review is given of recent projects of large antennas and some particular aspects relating to them. Author

N70-23567*# National Academy of Sciences-National Research Council, Washington, D.C. Div. of Engineering.
USEFUL APPLICATIONS OF EARTH-ORIENTED SATELLITES: POINTS-TO-POINT COMMUNICATION PANEL 7
1969 157 p refs
(Contract NSR-09-012-909)
(NASA-CR-109330) Avail: CFSTI CSCL 22B

A communication satellite able to interrogate and collect data from large numbers and types of widely distributed data collecting platforms, and subsequently to relay those data to specific centers for processing data (ground data handling (GDH) centers) is considered. When coupled with data processing centers geared to the requirements of particular services such points-to-point communication satellites promise sizable benefits to the nation and ultimately to all mankind. The task undertaken on points-to-point communications in this study of practical application of earth-oriented satellites begins with a survey of the global communications traffic presented by the complex of data collecting platforms and ends with findings and recommendations whose implementation could help make the dream a reality. Author

N70-23568# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory.
THE REFLECTION FROM AND TRANSMISSION THROUGH AN INHOMOGENEOUS PLATE OF A PLANE ELECTROMAGNETIC WAVE
Henning Bach Sep. 1967 55 p refs
(R-62) Avail: CFSTI

The reflection and refraction of a plane electromagnetic wave by an inhomogeneous plate surrounded by homogeneous media is investigated. The permittivity of the plate is assumed to vary linearly in the direction perpendicular to the surfaces of the plate. Airy functions are used in the description and expressions for the reflection coefficient, the transmission coefficient and the field inside the plate are obtained. The relations between the formulas for the inhomogeneous plate and the corresponding formulas for a homogeneous plate are studied in detail. Some numerical results are given. Author (ESRO)

N70-23578# Bonn Univ. (West Germany).
BASIC QUESTIONS OF THE PROPAGATION OF VLF WAVES
H. Volland Duesseldorf Deut. Ges. fuer Ortung und Navigation 1969 23 p refs Presented at the Intern. Navigation Meeting, Hamburg, 28–30 Oct. 1969
Avail: CFSTI

The propagation of Very-Low-Frequency (VLF) waves in the earth-ionosphere waveguide is viewed on the basis of the ray theory and the waveguide-mode theory. The relative usefulness of each theory is discussed and the scope of applicability of each of them is defined. Author (ESRO)

N70-23594*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN IMPROVED HORN FEED WITH TWO MODES FOR SHALLOW PARABOLOID ANTENNAS [VERBESSERTER HORNERREGER MIT ZWEI WELLENTYPEN FUER FLACHE PARABOLANTENNEN]
Elfriede Ludwig et al 10 Sep. 1969 13 p refs Transl. into ENGLISH from Werthoven Res. Inst. AEU, v. 23, pt. 4, 1969 p 209–215
(Contract NAS7-100)
(NASA-CR-109325) Avail: CFSTI CSCL 09E

A method for achieving a higher degree of antenna efficiency for large reflectors by improving the feed is presented. The improvement in using a conical improved horn feed in a Cassegrain antenna versus the classic horn excitation is examined, and an excitation system for this horn is investigated. The field intensity ratios, aperture diameter, and configurations are discussed. It is concluded that in the optimum case, and increase in the antenna effectiveness of 8 to 80% is achieved by supplemental use of the conical improved horn feed. F.O.S.

N70-23603*# Illinois Univ., Urbana. Biological Computer Lab.
AUTOMATIC DETERMINATION OF INVARIANCE IN MACHINE CODED SPEECH
John Schill 1 Dec. 1968 64 p refs
(Grant NGR-14-005-111; Contract AF 33(615)-3890; Grant AF-AFOSR-7-67)
(NASA-CR-109375; AD-683747; AFOSR-69-0454TR; BCL-7.4) Avail: CFSTI CSCL 17B

A method is described for determining significant patterns for the identification of spoken words automatically. The method is based on work of Gazdag, and uses his concept of significant subsequences SSS, sequences of common machine events that employs a machine representation of spoken words. An algorithm

was developed and is described for computing the SSSs. A program was implemented on the illiac II. Examples of the zeroth order of the program and the computed first and second order SSSs are given. In all computations applied to spoken digits, the SSSs converged at most by the second order SSS. Discussions of the data input and output and the flow chart of the program are appended. Details of the sampler developed for Gazdag's processor are given. Results suggest that the algorithm and sampler will enable identification of true SSSs for words other than spoken digits. Author (TAB)

N70-23660 National Lending Library for Science and Technology, Boston Spa (England).

TRANSMISSION OF PCM SIGNALS ON ORDINARY AND SPECIAL COAXIAL CABLES

G. Paladin et al 21 Nov. 1969 20 p refs Transl. into ENGLISH from Proceedings of the 69th Ann. Meeting of the Assoc. Elettrotecnica Ital. B.e. 11/1968
(NLL-Trans-2595-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Comparative, theoretical, and practical consideration is given the possibility of using normal and new type coaxial cables for the transmission of pulse code modulation. Definitions are given of repeater efficiency parameters along with a description of the simulating circuits suitable for the measurement of these parameters. Experimental data for cables with small diameter tubes are given. J.M.C.

N70-23680# Institute for Telecommunication Sciences, Boulder, Colo.

GROUND WAVE PROPAGATION IN A NORMAL AND AN IONIZED ATMOSPHERE

J. Ralph Johler Jul. 1969 69 p refs
(ESSA-TR-ERL-121-ITS-85) Avail: SOD $0.65

Ground wave propagation in the presence of intense atmospheric ionization, such as may occur as a result of ionizing radiation from nuclear events, is studied. The influence of an enhanced dielectric constant for the atmosphere is also considered. It is concluded that extremely high ionization sources are necessary to produce sufficient ions to completely attenuate the ground wave because of the high ion-neutral collision frequency at the ground level. The analysis method is immediately applicable to the study of ground wave propagation in the ionized atmosphere of a planet or other celestial body, since this requires only the trivial but numerically significant modification of the radius of curvature of the ground. A computer program is presented which can calculate the ground wave in both the normal and the ionized atmosphere. The altitude above ground of either transmitter or receiver or both transmitter and receiver can be taken into account. Author

N70-23692# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

WAVE PROPAGATION ON A LONGITUDINALLY MAGNETIZED FERRITE BAR IN AN ELECTRICALLY ANISOTROPIC ENVIRONMENT [ZUR WELLENAUSBREITUNG AN EINEM LAENGSMAGNETISIERTEN FERRITSTAB IN ELEKTRISCH ANISOTROPER UMGEBUNG]

E. Neckenbuerger Nov. 1969 23 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 14, no. 5, 1962 p 282–288
Prepared for Lincoln Lab., MIT
(AZT-69-634-GELL) Avail: CFSTI

In accordance with a phenomenological theory of J. A. Weiss, a few points are presented regarding wave propagation of a longitudinally-magnetized ferrite rod on the axis of a rectangular waveguide. Up to a certain cutoff frequency, this type of conduction produces only a single mode with elliptical polarization, whose ellipticity decreases when the magnetic field or the frequency increase. A mode of this type can also occur if the electrical isotropy of the ferrite rod is disturbed by one or two conducting plates located perpendicular to the electric vector of the wave. Several experiments were conducted, whose results are in agreement with these conclusions. A monotonic increase in damping was attained with an increasing magnetic field by using a ferrite rod split in half lengthwise and a resistance foil inserted in the center. An amplitude modulator and switch for microwaves, operating on this principle, are described. Further possible applications for the investigated propagation effects are discussed. Author

N70-23697# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

STATE-OF-THE-ART AND TECHNOLOGY OF ELECTROMAGNETIC AND ACOUSTIC DELAY LINES [STAND UND TECHNIK ELEKTROTECHNISCHER UND AKUSTISCHER VERZOEGERUNGSLEITUNGEN]

Josef Benger Dec. 1968 156 p refs In GERMAN
(Contract T-731-I-203)
(RR-12-68) Avail: CFSTI

The theory, design and existing types of delay lines, both electromagnetic and acoustic are discussed, particularly passive filters with both lumped and distributed constants and also ultrasonic delay lines. Transducers used in ultrasonic delay lines and means of bonding them to the sound carrier are discussed. ESRO

N70-23698# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

RESOLUTION AND AMBIGUITY IN LOCATION WITH FREQUENCY-SHIFT AND PHASE-SHIFT KEYED PULSES [AUFLOESUNGSVERMOEGEN UND VIELDEUTIGKEIT BEI DER ORTUNG MIT FREQUENZ- UND PHASENUMGETASTETEN IMPULSEN]

W. Bachmann (Ph.D. Thesis—Tech. Hochschule Aachen) May 1969 108 p refs In GERMAN
(Contract T-932-I-203/PH-1)
Avail: CFSTI

The degree of approximation of binary coded frequency and PHASE-shift keyed positioning signals by ideal types of ambiguity functions is treated, as well as the influence of the individual signal and receiver parameters of this problem. It is shown that coherent methods of modulating positioning pulses such as Barker Coding and simple binary keying are generally not applicable because of ambiguity. The best results should be obtained with incoherent binary frequency keyed pulses, although this method gives a worse signal-to-noise ratio and Doppler resolution. Author (ESRO)

N70-23701# Deutsche Gesellschaft fuer Ortung und Navigation e. V., Duesseldorf (West Germany).

EFFECT OF WAVE PROPAGATION UPON RADIO LOCATION

E. Vocke 1969 8 p Transl. into ENGLISH from the German Presented at the Intern. Navigation Meeting, Hamburg, 28–30 Oct. 1969
Avail: CFSTI

The needs of users such as aviation and maritime organisations, surveyors and instrument manufacturers who are interested in wave propagation effects at frequencies beyond 1 GHz are reviewed. ESRO

N70-23703# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany). Dept. of Telecommunications.

ON THE CONVERSION FROM FREQUENCY MODULATION INTO AMPLITUDE MODULATION WITH MULTIPATH PROPAGATION

F. Schmitt Jun. 1968 15 p refs Presented at the URSI Symp., Stresa, Italy, Jun. 1968
(Contract T-833-I-203/5-1)
Avail: CFSTI

The resultant of frequency-modulated rays differing in time of arrival contains amplitude modulated components of the modulation frequencies. The ratio of the AM-components of different

modulation frequencies in the case of two rays allows one to draw conclusions about the time difference between them. An extension to the case of many rays, uniformly distributed over a certain path-length width, yields a relationship between the above ratio and the whole path-length width. Author (ESRO)

N70-23704# Lowell Technological Inst. Research Foundation, Mass.
STUDY DIRECTED TOWARD SIMULTANEOUS AIRGLOW AND RADIO OBSERVATIONS OF THE LOWELL IONOSPHERE
Daniel P. Hates Aug. 1969 41 p refs
(Contract F19628-68-C-0259)
(AD-698348; AFCRL-69-0366; LTIRF-298/1P; SR-1) Avail: CFSTI CSCL 4/1

The report is directed toward consideration of specific ways by which airglow emissions can augment ground based radio wave propagation studies of the lower ionosphere. It is specifically concerned with demonstrating the manner in which selected airglow lines and bands provide a convenient means for monitoring those aeronomical processes which exert decisive control on the radio propagation environment. It is specifically shown how simultaneous airglow-radio experiments can augment our knowledge of the dynamics and chemistry which control both the D and E regions of the ionosphere. New findings are reported concerning the latitude cut-off of conjugate streaming photoelectrons. Author (TAB)

N70-23711# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory.
LOSSES IN DIELECTRICALLY LOADED COAXIAL CABLES
J. Bach Andersen and J. Arnbak Apr. 1969 33 p refs
(R-70) Avail: CFSTI

Loss reduction in coaxial cables brought about by dielectric linings was experimentally observed, whereas various theoretical considerations fail to explain this feature. To clarify this vexing situation, consideration is given to the general conditions for obtaining lower losses by means of a thin concentric dielectric shell placed anywhere between the two conductors. The analytical criteria obtained agree well with numerical results derived directly from the exact Maxwellian field problem, but are much easier to apply and give a more unified insight into the significance of the various parameters concerned. The analytical method is particularly useful in the range of special interest, namely for thin linings. For electrically thick linings, the exact results may be understood from coupled-mode considerations. While not expalining the experimental observations, the present analytical theory admits of reduced attenuation in other, more favorable circumstances. This is in accordance with exact numerical computations, but restricts the use of quasi-static transmission-line theories to frequencies lower than previously assumed. Author (ESRO)

N70-23727# Institut fuer Geodaesie, Hanover (West Germany).
GEODETICAL DISTANCE MEASURING WITH MICROWAVE EQUIPMENT
W. Hoepcke Duesseldorf Deut. Ges. fuer Ortung und Navigation 1969 10 p refs Presented at the Intern. Navigation Meeting, Hamburg, 28 – 30 Oct. 1969
Avail: CFSTI

Modern microwave distance measurement equipment uses 3 cm waves, which are frequency modulated at 7.5 MHz. The modulation of waves reflected from a remote station is subjected to a phase comparison process from which the distance to the station may be obtained but this value is affected by refraction phenomena. Greater accuracy can be obtained by repeating the measurement several times with different carrier frequencies and using the mean value. The desired accuracy of 10 to 1 ppm can only be achieved if the field of refraction in the propagation path can be described by one of three models. ESRO

N70-23733# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
STUDY OF ACOUSTIC PROPERTIES OF SPEECH 2, AND SOME REMARKS ON THE USE OF ACOUSTIC DATA IN SCHEMES FOR MACHINE RECOGNITION OF SPEECH
Kenneth N. Stevens 15 Aug. 1969 53 p refs
(Contract F19628-68-C-0125; ARPA Order-627)
(AD-698352; AFCRL-69-0339; SR-12; Rept-1871) Avail: CFSTI CSCL 17/2

The acoustic properties of a number of different speech sounds as they appear in several phonetic contexts are described. This report supplements an earlier report on the same topic and presents data for stop and nasal consonants in prestressed position, for the timing of vowels, and for acoustic events following stressed vowels. The aims of this survey are to provide an indication of the kinds of acoustic attributes that should be extracted from the speech signal in a potential scheme for machine recognition of speech. Also included is a discussion of the roles that must be played by acoustic data and by linguistic constraints in schemes for automatic speech recognition. Author (TAB)

N70-23734# Office of Telecommunications Management, Washington, D.C.
OPERATIONAL REQUIREMENTS OF SHIPPING FOR A SATELLITE SYSTEM AND ITS CONTRIBUTION TO THE MARITIME DISTRESS SYSTEM
Charles Dorian Duesseldorf Deut. Ges. fuer Ortung und Navigation 1969 16 p Presented at the Intern. Navigation Meeting, Hamburg, 28 – 30 Oct. 1969
Avail: CFSTI

The requirements laid down by the Intergovernmental Maritime Consultative Organization (IMCO) are analyzed. It is found that a general navigation communication world-wide network based on synchronous satellites would provide the maximum possible safety to ships as well as improved communications to management of shipping, navigation and traffic control. ESRO

N70-23735# Deutsches Hydrographisches Institut, Hamburg (West Germany).
USER PROBLEMS
G. Zickwolff Duesseldorf Deut. Ges. fuer Ortung und Navigation 1969 14 p Presented at the Intern. Navigation Meeting, Hamburg, 28 – 30 Oct. 1969
Avail: CFSTI

Three types of emergency position-indicating radio beacons are described. The following problems concerning their application in combination with navigation methods are discussed: a) wave propagation over rough seas; b) limits to long-distance direction finding set by wave propagation; c) effects of coastal reflection or deflection; d) effect of ground conductivity upon location accuracy. ESRO

N70-23736# Royal Aircraft Establishment, Farnborough (England).
VLF RADIO WAVE PROPAGATION AND ITS INFLUENCE IN POSITION FIXING
B. Burgess Duesseldorf Deut. Ges. fuer Ortung und Navigation 1969 26 p refs Presented at the Intern. Navigation Meeting, Hamburg, 28 – 30 Oct. 1969
Avail: CFSTI

Some of the variations that occur in the earth-ionosphere waveguide are discussed that can contribute to errors in the Omega lines of position that are used to obtain navigational fixes on a world-wide basis. Effects due to conductivity variations in the earth's surface, night to day changes in the lower ionosphere, multi-mode propagation, and solar disturbances of the ionosphere are considered and attention is drawn to the use of the multiple frequencies transmitted in the Omega format to overcome some of these sources of error. The problem of lane ambiguity resolution in Omega as possibly required by fast moving sensors is also discussed. Author (ESRO)

N70-23749# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

EFFECTIVENESS OF A SELF-TUNING FILTER [EFFEKTIVNOST' SAMONASTRAIVAYUSHCHEGOSYA FIL'TRA]

V. A. Liknarev Dec. 1969 7 p refs Transl. into ENGLISH from Tr. Mosk. Aviats. Inst. (Moscow), no. 178, 1968 p 143–147 Prepared for Lincoln Lab., MIT

(AZT-69-662-RULL) Avail: CFSTI

The gain in a threshold signal as the result of self-tuning, as well as the gain produced by substitution of a quasi-optimum filter for an optimum one, are evaluated. It is concluded that the former increases with the degree of signal freedom, and that no more than 2 dB signal loss results from the latter substitution. Author

N70-23752# Page Communications Engineers, Inc., Washington, D.C.

ANTENNA MISALIGNMENT TROPOSCATTER TEST PROGRAM Final Technical Report

Oct. 1969 208 p refs

(Contract F30602-68-C-0071)

(AD-697093; RADC-TR-69-104; R-0201-00-30502) Avail: CFSTI CSCL 9/5

Troposcatter Communications experiments were conducted to determine the degradation in performance which results when the antenna system becomes misaligned and also to determine the improvement in performance which results when employing angle-diversity techniques. The antenna misalignment tests were performed on 105 and 170 mile paths using 8 GHz radio equipments. The 105 mile path employed dual-space-diversity eight-foot antennas. The 170 mile path employed twenty-eight foot angle-diversity antennas. Misalignment on the 105 mile path was achieved by a physical misalignment of the eight-foot antennas on both azimuth and elevation. Misalignment on the 170 mile path was simulated by operating thru any one of ten off-set feedhorn/beam. Performance as a function of misalignment was determined in terms of received signal level, fade rate, and the BER (bit error rate) of a binary FSK/TDM modem operating at rates from 154 kb/s up to 1.228 mb/s. The angle diversity experiments were conducted on the 170 mile path using the 8 GHz radio equipment and the angle-diversity antennas mentioned above. Performance as a function of 1, 3, 5, + 7 orders of angle diversity was determined for both binary FSK/TDM and FM/FDM operation. The FSK/TDM performance was that of BER for 154 kb/s to 1.228 mb/s transmissions; for FM/FDM it was the BER of a 2400 b/s and a 40.8 kb/s modem operated thru a voice/group channel of a 24 voice channel system. Author (TAB)

N70-23755# Joint Publications Research Service, Washington, D.C.

UNDERGROUND PROPAGATION OF RADIO WAVES

M. Dolukhanov 19 Feb. 1970 4 p refs Transl. into ENGLISH from Radio (Moscow), no. 1, 1970 p 42–43

(JPRS-49894) Avail: CFSTI

Current concepts of the structure of the earth's crust are reviewed in terms of the electrical parameters of electrical conductivity and relative dielectric constant. Based on the electrical parameters of the earth's crust, three possible configurations are considered for underground propagation of radio waves. The advantage of underground transmission is that the highly conductive sedimentary rocks are free from atmospheric interference and reception conditions are determined by the signal-to-noise ratio rather than by the absolute value of field strength at the reception point. R.B.

N70-23763 Saclant ASW Research Center, La Spezia (Italy).

SYNTHESIS OF THE BROADBAND DIRECTIVITY PATTERNS OF CIRCULAR ARRAYS

Corrado Barbalonga 1 Nov. 1969 36 p refs

(Saclantcen-TM-147) Avail: CFSTI

Some methods for the modification of the broadband directivity function of a circular array, which is considered as a particular case of a generalized array, are discussed. Theoretical formulas for directivity pattern synthesis are presented and examples show the practical limits for several approximate methods. Author (ESRO)

N70-23779# Joint Publications Research Service, Washington, D.C.

AN INVESTIGATION OF THE EFFECT OF OSCILLATOR FREQUENCY FLUCTUATION ON THE QUALITY OF A SDTs SYSTEM WITH INTERNAL COHERENCE [SELEKPSIYA DVIZHUSHCHIKHSYA TSELEI; MOVING TARGET SELECTION]

V. Ya. Plekin et al 13 Feb. 1970 11 p refs Transl. into ENGLISH from Radiotekhnika (Moscow), v. 24, no. 10, Oct. 1969 p 13–19

(JPRS-49827) Avail: CFSTI

The selection of moving targets (SDTs) system with internal coherence and phasing on the intermediate frequency is investigated. An analysis of the quality of operation was made considering the real statistical characteristics of the local and coherent heterodyne signals. Formulas for determining permissible spectral width of fluctuations in signals are developed. It is concluded that the presence of natural fluctuation in the frequency of local and coherent heterodynes substantially reduces the efficiency of the SDTs system. F.O.S.

N70-23797# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory.

DIRECTIVITY OF BASIC LINEAR ARRAYS

Henning Bach Jan. 1969 21 p refs

(R-68) Avail: CFSTI

Among the large variety of arrays of radiating elements employed by modern techniques, the simplest type is the uniform linear array. The simplest acoustic radiator is the isotropic source, and a uniform linear array of isotropic elements may be considered the basic array of acoustic sources. In electromagnetics no isotropic radiator exists. The short dipole is the simplest electromagnetic source. A uniform linear array of short dipoles may be considered the basic array of electromagnetic sources. Entirely different properties are obtained when the dipoles are parallel to the array axis (a collinear dipole array) and when the dipoles are perpendicular to the array axis (a parallel dipole array). The directive properties of these three basic types of arrays are considered. Author (ESRO)

N70-23798# Commissariat a L'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

INFRARED LINKS [LIAISONS INFRAROUGES]

Pierre Chartier Nov. 1969 41 p refs In FRENCH; ENGLISH summary

(CEA-BIB-154) Avail: CFSTI

Infrared link problems are reviewed involving emitters, receivers, and atmospheric transmission and modulation techniques. Author (ESRO)

N70-23809# Air Force Systems Command, Bedford, Mass. Div. of Electronic Systems.

INTEGRATED COMMUNICATION, NAVIGATION AND IDENTIFICATION [INTEGRIERTE ANLAGE FUER NACHRICHTEN, NAVIGATION UND KENNUNG]

William J. Sen Duesseldorf Deut. Ges. fuer Ortung und Navigation 1969 20 p In GERMAN Presented at the Intern. Navigation Meeting, Hamburg, 28–30 Oct. 1969

Avail: CFSTI

Contemporary military aircraft have separate electronic equipment for voice communication, navigation and identification. The common purpose, transmission of information, has led to an integrated concept of communication (C), navigation (N) and

identification (I) known as CNI. Former investigations of this concept showed that it was not feasible for economic and technical reasons. Possible applications of integrated CNI are discussed and it is concluded that the new techniques of digital processing and microminiaturization gives good chances of success. ESRO

N70-23820# Ateliers de Constructions Electriques de Charleroi (Belgium).
ELDO A PROGRAM: STUDY REPORT OF THE GUIDANCE TRANSPONDER MARK 3 [PROGRAMME ELDO A: RAPPORT D'ETUDE DU REPONDEUR DE GUIDAGE MARK 3]
P. Walch, G. Rion, and P. Simon 30 Sep. 1968 268 p refs In FRENCH Sponsored by ELDO
(EN/GI/PS-PW/LP-68195) Avail: CFSTI

This report reviews the development of the ELDO guidance transponder MARK 3. The general specifications of the transponder and the characteristics of the diplexer, receiver and emitter circuits are outlined. A complete analysis of the control loop is also given. ESRO

N70-23829# Forschungs Institut fuer Hochfrequenzphysik, Werthhoven (West Germany).
RADAR RECEIVER FOR A SURVEILLANCE DEVICE WITH MINIMUM SIGNAL DIRECTION FINDING METHOD [RADAREMPFAENGER FUER EIN RUNDSICHTGERAET MIT MINIMUMPEILUNG]
G. Kosel (Ph.D. Thesis—Aachen Univ.) May 1969 128 p refs In GERMAN
(Contract T-833-I-203/7-1)
(RR-2-69) Avail: CFSTI

After a short description of target tracking radar, the principles of the suitable methods for this purpose are explained. In addition the principle of the constructed surveillance receiver is described. Methods that use phase comparison by discrimination of delay differences of both received signals are not discussed because of ambiguity. In constructing the antenna, care was taken with the distance between the phase centers of the excitors as this should be small compared to the wavelength used. In phase-sensitive detection, signal processing by the correlation principle is used. Autocorrelation is treated, and the resulting probabilities and angle measuring accuracy are discussed. The trial model is described, and the measurement results are discussed. Author (ESRO)

N70-23839# Hamburg Univ. (West Germany). Inst. fuer Radiometeorologie und Maritime Meteorologie.
STRUCTURE OF THE TROPOSPHERE AND ITS INFLUENCE UPON WAVE PROPAGATION
Gerda Fengler Duesseldorf Deut. Ges. fuer Ortung und Navigation 1969 20 p refs Presented at the Intern. Navigation Meeting, Hamburg, 28-30 Oct. 1969
Avail: CFSTI

The manifold phenomena and structures of the troposphere have widely different influences upon radio wave propagation. Numerous phenomena are known and taken into account in practice. This is especially true where the main stress is laid upon statistical statements as in the planning of a transmitter network for radio and television or of microwave radio links. Many phenomena, however, are still being investigated by research groups throughout the world and give rise to new investigations. In the field of radio meteorology, further interesting results have to be expected which will be of interest not only for radio wave propagation, but also for other purposes of meteorology where indirect measuring methods are increasingly gaining importance. Author (ESRO)

N70-23852# Joint Publications Research Service, Washington, D.C.
MEASUREMENT OF SPACE-TIME STRUCTURE OF HIGH FREQUENCY COMPONENTS OF WIND WAVES
K. V. Konyayev 6 Mar. 1970 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Fiz. Atmosfery i Okeana (Moscow), v. 6, no. 1, 1970 p 104–110
(JPRS-49998) Avail: CFSTI

A two-dimensional antenna array tuned to oscillations with the highest wave number were used to record and measure high-frequency wind components. The measurements were made with weak, relatively constant wind, the direction of which corresponded to the main direction of wave propagation. The spectra of measured signals with the array oriented in the main direction of wave propagation show all three calculated peaks. More detailed analysis of the measured spectra indicates that the spectral peaks in the main direction of wave propagation are broader than in the perpendicular directions and somewhat broader than the calculated peaks, which can be explained by nonlinear interaction of the waves of varying lengths. This interaction must be taken into account when analyzing such processes as reflection of sound and electromagnetic oscillations from the wave surface of the sea. R.B.

N70-23865# Max-Planck-Institut fur Aeronomie, Lindau Uber Northeim (West Germany).
INFLUENCE OF THE TROPOSPHERE ON LOW INCIDENT SATELLITE SIGNALS IN THE RANGE OF WAVELENGTH 15 TO 2 m
Gerd Hartmann Duesseldorf Deut. Ges. fuer Ortung und Navigation 1969 14 p refs Presented at the Intern. Navigation Meeting, Hamburg, 28–30 Oct. 1969
Avail: CFSTI

The amplitude of radio signals from the beacon satellite Explorer 22 has been recorded since November 1964 for the purpose of obtaining the ionospheric electron content from the Faraday effect. On a considerable number of occasions when the satellite was at low elevation angles, sudden increases in signal amplitude were observed. From detailed investigations it is concluded that these enhancements are the result of diffraction of the radio waves by structures within the troposphere. These effects were observed on 20 MHz, 40 MHz, 41 MHz and 136 MHz. Author (ESRO)

N70-23870# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).
EXPERIMENTAL INVESTIGATIONS OF A MODIFIED BACKFIRE ANTENNA [EXPERIMENTELLE UNTERSUCHUNGEN AN EINER MODIFIZIERTEN BACKFIRE-ANTENNE]
W. Soentgerath Dec. 1968 44 p refs In GERMAN
(Contract T-833-I-203/2-5)
Avail: CFSTI

The design of a modified backfire antenna for reception of wide-band UHF television signals is described. The antenna dimensions were optimized by means of model studies, and the frequency response was matched by means of a simple matching circuit. ESRO

N70-23874# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).
EXPERIMENTAL INVESTIGATIONS OF YAGI ANTENNAS [EXPERIMENTELLE UNTERSUCHUNGEN AN YAGI-ANTENNEN]
W. Soentgerath May 1968 50 p refs In GERMAN
(Contract T-833-I-203/2-5)
Avail: CFSTI

The radiation patterns and matching behavior of Yagi antennas and Yagi antenna arrays were investigated and a suitable design was developed. As it is difficult to obtain high gain with a single Yagi antenna, a Yagi array was designed and the radiation pattern was optimized. Investigations were also conducted to match these antennas to a commercial antenna feed. ESRO

N70-23878# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).
TECHNICAL CONCEPT AND TESTING OF THREE OPTIMAL FILTERS [TECHNISCHE KONZEPTION UND PRAKTISCHE ERPROBUNG VON DREI OPTIMALFILTERN]
B. Naegele Apr. 1968 63 p In GERMAN
(Contract T-833-I-203-3-1)
(RR-2-68) Avail: CFSTI

The design and development of three optimal filters for correlating a modulated signal are described. In the case of suitable modulation code sequences, this corresponds to pulse compression. In contrast to a correlation receiver which needs a reference signal, with the optimum filter the correlation appears through the filter itself. The transmission is selected so that the autocorrelation function itself corresponds to pulse compression. This will, above all, be established while the transmission within its entire duration becomes, with a suitable code sequence, frequency or phase modulated. The advantage of a modulated signal compared with an unmodulated square wave impulse of the same duration and the same signal to noise ratio is that the local resolution is increased by the factor of the greater bandwidth. A Barker code was used for modulation because of the advantageous ratio of the amplitudes of the principal and secondary maxima. ESRO

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N70-22513# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEPENDENCE OF THE BASIC PARAMETERS AND STRUCTURE OF INFORMATION STORAGE SYSTEMS ON THE CHARACTERISTICS OF DIGITAL COMPUTERS
E. I. Mamonov 8 Aug. 1969 23 p refs Transl. into ENGLISH from Tsifrovaya Tekhn. Vychislitelnaya i Programmirovan (USSR), no. 3, 1967 p 120–129
(AD-698537; FTD-MT-24-164-69) Avail: CFSTI CSCL 9/2

A method is examined of determining the basic parameters and logic structure of machine memory systems. The quantitative characteristics of algorithms of problems solved and the features of the logic of control and the structure of computers are considered. Author (TAB)

N70-22560# California Univ., Berkeley.
HELP: A QUESTION ANSWERING SYSTEM
Roger Roberts 11 Apr. 1969 29 p refs
(Contract ARPA SD-185)
(AD-698316; P-13) Avail: CFSTI CSCL 9/2

HELP - A Question Answering System - enables a user, sitting at a console of a time-shared computer, to obtain information on questions typed in. This information might concern the operating system itself, the format of commands to the user interface executive program, the use of a selected subsystem, or an area totally separate from the computer. The content of the data base in HELP is completely arbitrary, and determined by the creator of each individual system. Questions are presented to HELP in standard English. A second system, called QAS, was developed to enable a user to conveniently generate a HELP program. The paper will discuss the structure of both programs. TAB

N70-22595*# Martin Marietta Corp., Denver, Colo.
POTENTIAL APPLICATIONS OF DIGITAL TECHNIQUES TO APOLLO UNIFIED S-BAND COMMUNICATIONS SYSTEM Final Report, 1 Jul. 1969–23 Feb. 1970
Feb. 1970 134 p refs
(Contract NAS9-9852)
(NASA-CR-180300; MCR-70-34) Avail: CFSTI CSCL 09B

The feasibility was studied of digital transmission of real-time, standard format TV, together with voice and all the other data that must be returned from the Apollo spacecraft. The principal benefit offered by a digital system is a reduction in the RF power required to transmit a good picture and reliable data. To achieve this improvement it is necessary to use two techniques made possible by converting to an all-digital system: error-correcting codes and data compression. Data compression makes each transmitted bit more important so that fewer errors can be tolerated, and error correction gives more improvement at low error rates. Author

N70-22599 Carnegie-Mellon Univ., Pittsburgh, Pa.
SOURCEBOOK FOR OSD: AN OPERATING SYSTEM DESIGNER
Peter Anthony Freeman (Ph.D. Thesis) 1969 194
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-20306

The ultimate goal of the research reported here is a program to design and produce operating systems for digital computers; this document only reports on initial investigations and is intended to serve as a sourcebook for further work. The basic idea of OSD is that the task of creating an operating system can be formulated so that the current techniques of artificial intelligence permit one to obtain useful solutions. Briefly considered are problems encountered in current systems and representation of the design task and a plan for realizing OSD is considered. The problem of creating an operating system is changed into that of designing a complete allocation policy for all of the resources of the computing system and of implementing this policy as machine code. Presented is a language for stating design problems to OSD and one in which OSD can state allocation policies. The problem that OSD must solve is the choice of an optimal policy from the space defined by the output language. Dissert. Abstr.

N70-22624# Stanford Univ., Calif. Dept. of Computer Science.
DESIGN – THEN AND NOW Technical Report
George E. Forsythe Sep. 1969 19 p refs
(Contract N00014-67-A-0112-0029)
(AD-698799; CS-140) Avail: CFSTI CSCL 9/2

Design and its subprocesses of analysis, synthesis, and optimization are defined. Design in 1946 is compared with its scope today, both in regard to things designed and the design tools. The paper is concluded with an exhortation to designers, mathematicians, and computer scientists to meld their capabilities for optimum design in the future. TAB

N70-22627# RAND Corp., Santa Monica, Calif.
THE GRAIL PROJECT: AN EXPERIMENT IN MAN-MACHINE COMMUNICATIONS Final Report
T. O. Ellis, J. F. Heafner, and W. L. Sibley Sep. 1969 27 p refs
(Contract DAHC15-67-C-0141; ARPA Order-189-1)
(AD-698802; RM-5999-ARPA) Avail: CFSTI CSCL 9/2

An interactive software-hardware computer-graphics system has been developed in which the displayed contents of a cathode ray tube (CRT) can be manipulated directly using a RAND Tablet and stylus. The design goals for this system were (1) to provide man-machine communication using only the CRT display and real-time interpretation of stylus motion, (2) to minimize ambiguous responses and make the operation apparent, (3) to make the system responsive with minimal distraction and delay, and (4) to make the system compete as a problem-solving aid. Computer programming via flowcharts was chosen to demonstrate the techniques. System responses on the CRT include location of the virtual position of the stylus, ink track representing its motion on the tablet, changes in display intensity, pictorial modification, and

English-language statements. The important results of this investigation is the demonstration of such an approach.
Author (TAB)

N70-22649# Oak Ridge National Lab., Tenn.
THE 1969 RSIC COMPUTER-BASED INFORMATION RETRIEVAL SYSTEM IN BRIEF
J. G. Jones, D. K. Trubey, and J. Gurney 14 Nov. 1969 29 p refs
(ORNL-TM-2719) Avail: CFSTI

The computer-based information retrieval system used by the Radiation Shielding Information Center (RSIC) since 1963 has been reprogrammed to take advantage of modern computer hardware and software. A brief description of the system is given to aid those using it and to inform those who might use it for their own information files.
Author (NSA)

N70-22691# System Development Corp., Santa Monica, Calif.
THE ADEPT-50 TIME-SHARING SYSTEM
Richard R. Linde, Clark Weissman, and Clayton E. Fox 5 Aug. 1969 38 p refs Sponsored in part by ARPA
(PB-186460; SDC-SP-3344) Avail: CFSTI CSCL 09B

The ADEPT-50 Time-Sharing System was designed to operate on the IBM 360 computer series. ADEPT is a general-purpose system designed to operate in a military context and to support a limited number of large compute- and I/O-bound programs that are dependent on large files of data; however, it can perform equally well with a large number of small programs that make limited demands on the system resources. This paper describes the novel aspects of the system architecture, which provide the user with the same tools for controlling his program as are used by the executive; discusses the systems built-in security provisions, which are unique in the industry; and explains the testing method used in system building, which sould be of interest to designers of multiprogramming systems.
Author (USGRDR)

N70-22693# Ohio State Univ., Columbus. Computer and Information Science Research Center.
EXTENDED FINITE STATE REPRESENTATION OF INFINITE MACHINES
Larry H. Reeker Sep. 1969 40 p refs
(Grant NSF GN-534-1)
(PB-187949; CISRC-TR-69-20) Avail: CFSTI CSCL 09B

The paper presents some results of the author's research in extension of finite state representation methods to infinite machines. Many of the definitions and theorems have a certain pedagogical value, in that they allow for a unified treatment of infinite automata, based upon the simpler notions applicable to finite automata.
Author (USGRDR)

N70-22695# Sandia Corp., Albuquerque, N.Mex. Computer Aided Design Systems Div.
PLT2D2: A PLOTTING PROGRAM FOR TODDY 2 DATA RESULTS
James H. Graham Sep. 1969 48 p Sponsored by AEC
(PB-187893; SC-DR-69-585) Avail: CFSTI CSCL 09B

The document is to serve as an explanation of the program PLT2D2 and as a reference guide to using the program. The program is intended to provide flexibility in plotting the numerical results of the dynamic analysis program TODDY-2.
Author (USGRDR)

N70-22778# Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
DERIVATIVE COMPUTER FOR THERMOGRAVIMETRIC ANALYSIS
Joseph S. Byrd Dec. 1969 7 p refs
(Contract AT(07-2)-1)
(DP-1211) Avail: CFSTI

A derivative computer was designed for use with an Ainsworth thermogravimetric analysis system. The basic circuit, a simple differentiator using an operational amplifier, is very stable and accurate.
Author (NSA)

N70-22849*# Westinghouse Electric Corp., Baltimore, Md. Field Engineering and Support Dept.
GROUND RECORDING AND PLAYBACK SYSTEM Final Report, Jul. 1968 – Dec. 1969
Dec. 1969 30 p refs
(Contract NAS5-11597)
(NASA-CR-109254) Avail: CFSTI CSCL 09B

The Goddard Space Flight Center playback facility for generating photographic images on film from ATS spin scan camera data is described. The data handling units were designed to interface with a film recorder electrically equivalent to the color film recorder now part of the ATX MSSCC equipment now at Rosman. In addition, a mode exists whereby a black and white film recorder may be used in lieu of the color recorder. In this mode any single color of a recorded ATS SSCC tape may be played back to form a black and white film record. The data input to this facility consists of digital tapes recorded at the Rosman and Mojave data acquisition sites, and analog data transmitted via a GFE ground data link from the Rosman site. This equipment is capable of manipulating the data prior to film exposure to meet specific experimenter needs; this manipulation consists of both spatial and intensity (color) changes. In addition, a study to specify the selection and addition of a small computer to the proposed facility was performed.
Author

N70-22854*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCIENCE DATA SYSTEMS
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 14–19 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 09B

The logic of an r-stage linear feedback shift register is investigated in detail. The state of the i-th two-state memory element at clock pulse interval is used to characterize the behavior of the register by its linear recurrence relationship and the i th stage contributes to the feedback when the Boolean multiplier is at state value 1. The summations are taken modulo 2 and e, a Boolean constant, is 0 for modulo 2 summing (exclusive-or) or 1 for the complement of modulo 2 summing (not exclusive-or). Cycle length or periodicity is determined by its generating function.
G.G.

N70-22888# Leasco Systems and Research Corp., Ltd., London (England).
ESRO DATABANK PROJECT: SYSTEM DESIGN SUMMARY. ELECTRONIC COMPONENTS AND MATERIALS
W. A. Martin (ESRO) Paris ESRO Dec. 1969 138 p Prepared for ESRO
(Contract ESTEC-615/68-RS)
(ESRO-CR-21) Avail: CFSTI

The first four volumes of the detailed system design specification for the ESRO databank project are summarized. The aim of the project is to create a databank of electronic component product data and test data for on-line interrogation, particularly at the European Space Research and Technology Center, and to provide a selective dissemination of information (SDI) service on new projects. Major subsystems are described including: data preparation unit; data take-on and validation; file maintenance; SDI matching; formatting for microfilm output device; graphics system; and printout on microfilm output device. A system for the digitizing, storing, retrieval and printout of line drawings has been developed and is briefly described. Examples of input and output forms, illustrations of the classification scheme, flowcharts, and outline program descriptions are included.
ESRO

N70-22891# Royal Aircraft Establishment, Farnborough (England).
ORES, A COMPUTER PROGRAM FROM THE ANALYSIS OF

RESIDUALS FROM PROP
Diana W. Scott Aug. 1969 17 p refs
(RAE-TR-69163) Copyright. Avail: CFSTI

The FORTRAN program ORES is described. It was written to tabulate and analyze the residuals of satellite observations used in orbit determinations with the program PROP. Details of the program are given for prospective users, and the output is described in detail for the benefit of observers who receive tables of residuals.
Author (ESRO)

N70-22941# California Univ., Livermore. Lawrence Radiation Lab.
A VERBALIZED COMPUTER OUTPUT SYSTEM
James L. Willows Oct. 1969 5 p refs
(PB-187895; UCRL-72103) Avail: CFSTI CSCL 09B

A description and sample are given of a verbal computer output system for use on a single CDC 6600 time-shared computer. The system is designed to 'read' messages to the teletype for routine interaction between programmer and computer, and brailling must be done manually by a message repeat mode.
USGRDR

N70-22951# Georgia Inst. of Tech., Atlanta. School of Information Science.
PDP-8: OPERATING SYSTEM
Jane H. Amick, Jorge Baralt-Torrijos, Robert W. Swears, and Gerald W. Wright 1969 55 p refs
(Grant NSF GN-655)
(PB-187883; GITIS-69-19) Avail: CFSTI CSCL 09/2

The present paper is a general description of an operating system for the PDP-8/1. The basic factor taken into account in the design of this operating system was a multiprogramming system which supports both conversational programs and batch processing based on a priority system. The paging structure of the computer permitted the design of a kind of virtual memory facility which releases the programmer from taking care of how the code is going to be allocated in core. This feature facilitates the roll-out function which permits the implementation of the priority system. In addition to this priority system, there is a protection system which controls the use of the computer by unauthorized people. The priority system and the protection system are strongly related by the fact that each user has a top priority for the execution of his job. In addition to this, requests from any number of terminals can be attended simultaneously, although only two jobs can be present in core as executing jobs. If some request cannot be attended immediately, it is enqueued and, on a priority basis, is attended when the active jobs are terminated.
Author (USGRDR)

N70-22961# Econometric Society, New Haven, Conn.
SIPPS MANUAL: THE SYSTEM OF INFORMATION PROCESSING FOR PROFESSIONAL SOCIETIES
Oct. 1969 142 p Revised
(PB-186483) Avail: CFSTI CSCL 05B

The System of Information Processing for Professional Societies (SIPPS) has been developed with the support of the National Science Foundation in order to meet the dual needs of professional societies: greater efficiency in both internal administration and scientific communication. Information handling is being automated so that fewer resources are consumed for administrative purposes and more can be released to the operation of communications networks required by scientific disciplines. The SIPPS system not only allows the staff of the professional society to perform administrative functions such as printing mailing lists, billing subscribers, and filling back orders more effectively, but it also opens up the possibility of providing information services to the discipline in the form of biographical and bibliographical indexing.
Author (USGRDR)

N70-22974# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALGORITHMIC SELECTION OF THE OPTIMUM STRUCTURE OF A DIGITAL CONTROL COMPUTER
E. E. Zulfugarzade et al 5 Sep. 1969 23 p refs Transl. into ENGLISH from the Russian Report
(AD-698529; FTD-HT-23-196-69) Avail: CFSTI CSCL 9/2

Various structures of general-purpose digital control computers are analyzed. Analysis of these structures has indicated that the selection of optimal structure may be reduced to the problem in mathematical programming where the equipment cost function is minimized with constraints specified by technical requirements. On algorithm for the selection of the optimum structure of an electronic digital computer is proposed.
Author (TAB)

N70-22978# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALGORITHMIC MACHINE ORIENTED LANGUAGE: ALMO
S. S. Kamynin et al 15 Aug. 1969 15 p refs Transl. into ENGLISH from the Russian Report
(AD-698528; FTD-HT-23-190-69) Avail: CFSTI CSCL 9/2

The document describes the ALMO programming language.
TAB

N70-23009# Georgia Inst. of Tech., Atlanta. School of Information Science.
EVALUATION TECHNIQUES OF REAL-TIME COMPUTER SYSTEMS: A SURVEY OF PRACTICES Internal Research Memorandum
Richard J. Greco 1969 35 p refs
(Grant NSF GN-655)
(PB-187860; GITIS-69-11) Avail: CFSTI CSCL 09B

The report is a discussion of evaluation techniques of real-time communications-based systems. Techniques of system performance evaluation that have been developed, and results of a state-of-the-art survey are presented.
Author (USGRDR)

N70-23078# Ministry of Technology, Orpington (England). Productivity Services and Information Div.
EXPERIENCE WITH A PILOT SCHEME AND THE TRANSITION STAGE TO FULL MECHANISATION
S. C. Schuler *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 7–26 (See N70-23076-10-34)
Avail: CFSTI

Changes in operations and some of the problems are discussed which occur in the transition from purely manual operation, through partial mechanisation, to a proposed comprehensive computer system in an organization handling 46,000 new titles annually. Partial mechanisation has involved the introduction of tape typewriters for typing bibliographic data and the production of printed indexes from these data using a bureau computer. The comprehensive system requiring an in house computer will permit SDI, subject searching, announcement bulletin and index production, and stock control to be carried out.
Author

N70-23082# Shell Research, Ltd., Sittingbourne (England). Woodstock Agricultural Research Centre.
AUTOMATION OF THE INFORMATION SERVICE IN AN INDUSTRIAL RESEARCH ESTABLISHMENT: HARDWARE AND ITS EFFECT ON IMPLEMENTATION AND PERFORMANCE
H. F. Dammers *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 51–66 refs (See N70-23076 10-34)
Avail: CFSTI

A comment is presented on hardware choice and its problems in the light of the experience gained in the development of computerized information facilities at the Shell Research Laboratories, Sittingbourne, UK. The environment in which the system operates is outlined as well as the objectives of the project and resources available. Computer configuration for data storage and retrieval operation at the site and links to other computers in the Company

are described and the cost/effectiveness ratio of the different operations is established. Finally future needs and developments are discussed. Author

N70-23195*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A METHOD OF HANDLING MULTIPLE FILE TAPES WITH OS/360
Jacques Pacquet (CNRS) Mar. 1970 39 p
(NASA-TM-X-63861; X-613-70-87) Avail: CFSTI CSCL 09B

A set of general routines to handle tapes on computers using OS/360 is described. More specifically, a method to read a multi-reel multifile data set on unlabeled tape and to generate on unlabeled or labeled tapes one or more multi-reel multifile data sets is described using the queued sequential access method of the operating system. The software used consists of a set of assembly language routines, callable from FORTRAN IV. A discussion of their construction and their potential use is given. Author

N70-23204*# Logicon, Inc., San Pedro, Calif.
FLIGHT COMPUTER AND LANGUAGE PROCESSOR STUDY
Raymond J. Rubey, William C. Nielsen, and Laurel Bentley Washington NASA Mar. 1970 141 p
(Contract NAS12-2005)
(NASA-CR-1520) Avail: CFSTI CSCL 09B

A higher level programming language suitable for the development of real-time aerospace programs is described. The programmer's reference manual for such a language and compiler considerations for the language's implementation are presented. The study plan itself consisted of using two candidate languages to code portions of a representative problem designed to be solved on a current computer; analyzing the resultant programs to select a base language for further definition; using the language thus defined to reprogram the same problem; and analyzing the second set of programs to enable further language definition and refinement. Clasp is considered a language that can do the job in the aerospace programming area and can be implemented for the computers of today and the near future without great expense. Author

N70-23213# California Univ., San Diego. Scripps Inst. of Oceanography.
PROGRESS IN IMAGE PROCESSING TECHNIQUES AND EQUIPMENT Final Report
Benjamin L. Mc Glamery, Madison L. Myers, Richard L. Ensminger, and Robert F. Howarth Nov. 1969 85 p refs
(Contract F08606-68-C-0017; ARPA Order-1062)
(AD-698359; SIO-REF-69-28) Avail: CFSTI CSCL 20/6

The report describes the current emphasis of image processing research at the laboratory. The following aspects of the work are described: image processing studies, sensor studies, the image processing computer system and image processing equipment. The image processing studies compare the performance of different methods of image restoration as a function of noise level in the degraded image. The sensor studies compare the noise characteristics for several different sensors used for recording images. The capabilities of the computer system used for image processing and the program philosophy are described. The characteristics of the image scanning and display systems used as input and output devices for the image processing facility are reported. Author (TAB)

N70-23263# Joint Publications Research Service, Washington, D.C.
CONVERSION OF INFORMATION FORM AND AUTOMATION OF RESEARCH
A. I. Kondalyev 4 Mar. 1970 16 p Transl. into ENGLISH from Akad. Nauk Ukr. RSR (Kiev), no. 7, 1969 p 35-45
(JPRS-49980) Avail: CFSTI

The information measurement technology in the automation of research is investigated by studying the information processing systems for raw data. Digital computers, and information converters are discussed. The aggregated complex of converters of the Institute of Cybernetics is described. F.O.S.

N70-23286*# Michigan Univ., Ann Arbor. Systems Engineering Lab.
THEORY AND DESIGN OF RELIABLE SPACECRAFT DATA SYSTEMS Quarterly Progress Report, 10 Feb. -9 May 1969
J. F. Meyer 20 May 1969 43 p refs Prepared for JPL
(Contract NAS7-100; JPL-952492; Proj. 02602)
(NASA-CR-109320; QPR-1) Avail: CFSTI CSCL 09B

A survey of literature related to each of the three areas of investigation included: (1) design and analysis of redundant combinational and sequential networks, (2) fault diagnosis of redundant systems at both the component and subsystem level, and (3) data system reliability analysis. Summaries of the individual surveys are presented. Each summary is based on a bibliography of 50 references selected from a total bibliography of about 500 entries. The latter is maintained in a card file at the University and will periodically be updated. The selected bibliographies are documented. The bibliography format chosen conforms closely to that of the IEEE publications. The authors' names, title of article, and name of source - book, periodical, or contract report - follow in succession. Then comes the name of the publisher (books), volume and number (periodicals), or company report/ADA number (reports). Following the data of publication, the length of books is indicated by the number of pages; the beginning and ending page numbers are given for all other articles. Author

N70-23267# Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).
EXTENDED SIMON LIBRARY: A DISCRETE EVENT SIMULATION PACKAGE
A. T. Boyd Jun. 1969 32 p refs
Avail: CFSTI

Experience with a number of discrete event simulations indicated areas where the ALGOL simulation package then in use, SIMON 2, could be improved. The facilities which received attention were those of list processing, creation and destruction of temporary entities, flexible report generation, time structures, and decision aids. It is believed that the fully extended package can now offer facilities which match or excel those available in other widely used simulation languages. Author (ESRO)

N70-23321*# Texas Univ., Austin. Dept. of Electrical Engineering.
A CLASSIFICATION AND SURVEY OF COMPUTER SYSTEM PERFORMANCE EVALUATION TECHNIQUES
P. R. Blevins and C. V. Ramamoorthy [1969] 36 p refs
(Grant NGR-44-012-144)
(NASA-CR-109326) Avail: CFSTI CSCL 09B

The widely distributed software capabilities coupled with increased compatibilities among hardware units is propagating an ever increasing multitude of computer systems. Such systems aim at a common goal - total system optimization. But achievement of this ultimate goal is being delayed by the absence of a theoretical basis capable of providing a reference for standardized evaluations and comparisons. The current computer system performance evaluation technology cannot be described in terms of standardized techniques involving established parameters. However, the technology can be partitioned with respect to system component (computing job, hardware unit, and operating system). Within these classifications this paper examines the methodology (analysis, simulation, synthesis) and parameters of typical evaluation techniques presently available. Their advantages and disadvantages are delineated. A comprehensive bibliography is provided. Author

N70-23327# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WRITING BINARY INFORMATION INTO OPTICAL

STORAGES IN INFORMATION SYSTEMS
L. I. Brodolin 13 Aug. 1969 18 p refs Transl. into ENGLISH from the Publ. "Yesesoyuznaya Konferentsiya po Informatsionn-Poiskovym Sistemam i Avtomatizirovannoy Obrabotke Nauchno-Teckhnicheskoy Informatsii" USSR, 1967 p 110–121
(AD-698523; FTD-HT-23-06-69) Avail: CFSTI CSCL 9/2

A survey of large-capacity optic memory systems is presented. These systems for storing binary information use the following data carriers: silver halide, Kalvar (a polyethylene teraphthalate layer 75 mu m thick), and thermoplastic and photochromic layers. Maximum resolution for these materials is 1000-2000 lines/mm, and storage duration is for years. Holographic laser systems are also cited. These use either of the above carriers, with writing speeds reaching 100,000 bits/sec., or 3-dimensional data carriers which are being closely studied by researchers, although it is not known whether data may be modified in this type of carrier. A Soviet contribution to the art of storing a large amount of data by optic mean, is the so-called raster photoscopic store, for which two patents were issued in 1961. The system uses a photographic plate and a lens raster to record an image (e.g., a punched card) on a section of film directly behind each lens of the lens raster. TAB

N70-23336# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROBLEMS IN CONTROL THEORY OF LOGIC NETS
V. G. Igolinskiy 5 Sep. 1969 28 p refs Transl. into ENGLISH from Dokl. Seminar "Teoriya Avtomatov" (USSR), 1967 p 3–32
(AD-698439; FTD-HT-23-167-69) Avail: CFSTI CSCL 9/2

The paper presents a theory for automatic checking of a fault location in special-purpose computers. Optimal algorithms are set up for checking the fundamental electrical and logic scheme of the computer. A complete general solution of the direct problem of checking is offered; the results of a check test are compared with a set of errors possible in the computer scheme in question. The schemes based on dynamic units with gate-type computing elements and delay lines are dealt with. Only the logic net is investigated. TAB

N70-23340# Sandia Corp., Albuquerque, N.Mex.
COMPUTER-AIDED PRECISION GRAPHICS
W. C. Burd, T. I. Ristine, and R. E. Thompson 5 Jun. 1969 23 p refs Presented at the 3rd Natl. Conf. of the Assoc. for Precision Graphics, 5 Jun. 1969
(PB-187811; SC-R-69-1321) Avail: CFSTI CSCL 09B

A typical printed circuit board design is generally changed three or four times before release to manufacture. Lead time to produce a board needs to be minimized because printed circuit boards are usually the last item to be designed and the first item needed in the production cycle. Interactive computer graphics is eminently suited to any problem which requires multiple runs and dynamic computer communication. Specifically, the paper describes the development of a system to make design changes at a cathode ray tube display console. Author (USGRDR)

N70-23450# Rome Air Development Center, Griffiss AFB, N.Y.
AN ANALYSIS OF COMPUTER GRAPHICS IN A RASTER FORMAT DISPLAY Final Report
Richard A. Metzger Nov. 1969 88 p refs
(AD-698756; RADC-TR-69-321) Avail: CFSTI CSCL 9/2

An attempt was made to analyze the problems associated with the presentation of computer generated graphic data in a raster scan (or television) type of display. This type of display has been used extensively with Digital-to-Video (D/V) Converters for the presentation of alphanumerics and symbology, with the D/V Converter performing the transformation from the digital data of the computer to the video signal compatible with the raster scan display. However, the problem of graphics generation within such a system has only recently been addressed. The primary constraint of the system, with respect to graphics generation, is the restrictive Cartesian grid that is imposed by the raster scan format. After a brief examination of the techniques of D/V Conversion, the paper considers the peculiar problems associated with graphics generation. Algorithms are derived to allow the generation of straight lines, circles, parabolas and arcs within the raster format. These algorithms are independent of raster line standard and are amenable to most computer programming languages. All algorithms are verified utilizing a general purpose computer and D/V Converter, and are then analyzed with respect to display presentation in terms of end point accuracy, uniformity and appearance. Author (TAB)

N70-23466*# Texas Univ., Austin.
RECOGNITION AND REPRESENTATION OF PARALLEL PROCESSABLE STREAMS IN COMPUTER PROGRAMS
1969 102 p refs
(Grant NGR-44-012-144)
(NASA-CR-109336) Avail: CFSTI CSCL 09B

Techniques for detecting subtask parallelism in arithmetic expressions and detecting parallel processable segments within a single program are presented. Concepts of explicit and implicity parallelism are defined. The technique for detecting parallel processable segments is incorporated in the form of a FORTRAN recognizer program. This recognizer inputs a source program also in FORTRAN and outputs the parallel processable segments of the source program. Details, limitations, and overall flow charts of the recognizer are also given. In order for parallel processing to be effective, the overhead which accompanies this mode of operation must be minimized. In addition, it is felt that successful recognition of these streams at compilation time will minimize overhead during execution time. Author

N70-23482# Joint Publications Research Service, Washington, D.C.
PERMANENT MEMORIES OF DIGITAL COMPUTERS
Yevgeniy Arkad'yevich Brik 3 Mar. 1970 8 p refs Transl. into ENGLISH of the book "Postoyannyye Zapominayushchiye Ustroystva Tsifrovykh Mashin" Moscow, Gosenergoizdat, 1969 p 1–8
(JPRS-49965) Avail: CFSTI

Problems of the construction of several modern, random access permanent memories (PM) used in digital equipment are analyzed. The principal advantages and disadvantages of various types of PM are discussed. Permanent memories without electrical rewriting of stored information are described. Author

N70-23544# Istituto Superiore di Sanita (Italy). Lab. di Fisica.
AUTOMATIC CONTROL OF WRITING ON TELETYPE BY ANALOGUE TO DIGITAL CONVERTER [DISPOSITIVO AUTOMATICO DI SCRITTURA SU TELESCRIVENTE PER CONVERTITORI ANALOGICO-DIGITALI]
R. Biancastelli and C. Bosio 26 Jun. 1969 46 p refs In ITALIAN; ENGLISH summary
(ISS-69/26) Avail: CFSTI

A readout system is described which can record from an unlimited number of 256-channel analog-to-digital converters or other digital equipments, connected in the "slave read mode". This readout system normally controls a typewriter at 6 characters per second, but the output pulse train may be easily modified to driving others output units. Micrologic circuits are used almost exclusively in the design of the circuit. Author

N70-23609*# International Business Machines Corp., Huntsville, Ala. Federal Systems Div.
FORMAT 2: SECOND VERSION OF FORTRAN MATRIX ABSTRACTION TECHNIQUE. VOLUME 2, SUPPLEMENT 2: DESCRIPTION OF DIGITAL COMPUTER PROGRAM SYSTEM/360 Final Report, Jan. – Sep. 1968
C. G. Hooks Wright-Patterson AFB, Ohio. AFFDL Feb. 1969 82 p refs
(Contract NAS8-14000)
(NASA-CR-109332; AFFDL-TR-66-207-Vol-2-Suppl-2;

Rept-68-261-0001) Avail: CFSTI CSCL 20K

A detailed description of the conversion effort for implementing format II on the system/360 using direct access 1/0 is presented. The conversion, coding, changes, and system/360 job control language are presented in detail. A timing comparison with the format II 7094 timer is also presented. The data input of format II is unchanged except that save statements are not usable at present. The output is unchanged except that some trace statements to show time of execution for each phase have been added. Author (TAB)

N70-23613# Mitre Corp., Bedford, Mass.

THE NUMBER OF MESSAGES THAT CAN BE STORED ON A DRUM Technical Report

R. A. Gildea and D. F. Votaw, Jr. Nov. 1969 37 p refs

(Contract F19628-68-C-0365)

(AD-698762; MTR-952) Avail: CFSTI CSCL 9/2

Messages arriving at a store-and-forward switch are stored in a drum. Each message stored takes up a number of blocks of drum storage that depends on the message length in characters. It is assumed in the report that the arriving messages are drawn at random from a message population; thus the number, say N, of messages that fill the drum is a random variable. It is shown, by means of renewal theory, that the distribution of N is approximately a normal distribution whose mean and variance are simple functions of the drum size and the parameters of the message population. Illustrative examples are given. An estimate of the expected fraction of wasted characters of drum storage is also shown. Author (TAB)

N70-23614# Mitre Corp., Bedford, Mass.

AFICCS DISPLAY SOFTWARE RECOMMENDATIONS Technical Report

Otto W. Beebe Nov. 1969 48 p refs

(Contract F19628-68-C-0365)

(AD-698763; MTR-945; ESD-TR-69-363) Avail: CFSTI CSCL 9/2

The document summarizes a study of the AFICCS (Air Force Integrated Command Control System) display system. Currently available AFICCS display features are reviewed and deficiencies, or lack of existence, are noted. Recommendations for improvements are segregated into two categories; near-term and long-range. Author (TAB)

N70-23633# National Physical Lab., Teddington (England). Central Computer Unit.

A SOFTWARE SCHEME FOR TEXT OUTPUT ON VISUAL DISPLAY DEVICES

Joyce Dickerson, C. W. Nott, and B. R. Heap Dec. 1969 16 p

(NPL-COU-8) Copyright. Avail: CFSTI

A software scheme written for displaying text is described. It is based on the NPL Graphical Output Scheme and can cater for a number of display devices. The output device considered is the Tektronix storage tube with a normal display of 32 lines of 50 characters. ESRO

N70-23640# Raytheon Co., Alexandria, Va. Autometric Operation.

COMPUTER ASSISTED TARGET ANALYSIS Final Report

Margo J. Kelly and John B. Kellom Nov. 1969 98 p

(Contract F30602-69-C-0194)

(AD-698761; RADC-TR-69-357) Avail: CFSTI CSCL 15/7

The Computer Assisted Target Analysis program cataloged in computer form the ground truth data collected at the UNDERBRUSH Test Range, Eglin Air Force Base, Florida. A Fortran IV program compatible with the GE-645 computer was developed for storing, retrieving, and correlating the data, and providing a means for updating as more data are compiled. Contained within the report is a complete program documentation including step by step operating procedures and logic flow diagrams. In addition, the data reduction methodology and program test results are described. Author (TAB)

N70-23649*# Michigan Univ., Ann Arbor. Systems Engineering Lab.

THEORY AND DESIGN OF RELIABLE SPACECRAFT DATA SYSTEMS Annual Report, 10 Feb. 1969 – 9 Feb. 1970

J. F. Meyer 1 Mar. 1970 295 p refs Prepared for JPL

(Contract NAS7-100; JPL-952492; Proj. 02602)

(NASA-CR-109339; AR-1; QPR-4) Avail: CFSTI CSCL 09B

Permanent memory faults in sequential switching systems, and the relationship between such faults with the resulting system behavior are investigated for designing fault tolerant systems. It was shown that a succession of memory faults can be regarded as a single fault which is the functional composition of all the faults in the succession. Three different types of fault masking were formulated: equivalence, inclusion, and reset masking relative to some subset. Stuck-at faults are defined for state-assigned machines and are considered a proper subclass of stable faults. Results were obtained that relate the semigroup structure to the structure included by the natural ordering and an investigation of fault tolerant machine design was initiated. F.O.S.

N70-23656*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

CIRCAL-2: A GENERAL-PURPOSE ON-LINE CIRCUIT-DESIGN PROGRAM. USER'S MANUAL

James R. Stinger and Michael L. Dertouzos May 1969 75 p

(Grant NGL-22-009-019; Contract Nonr-4102(01); DSR Proj. 76152)

(NASA-CR-109363; ESL-R-381) Avail: CFSTI CSCL 09B

CIRCAL-2 is a general purpose on-line circuit analysis program with the following main features: 1) The user may choose any one of several existing analysis routines (such as frequency, nonlinear transient, statistical, etc.) in order to analyze a network that has already been inputted. 2) Networks are inputted in a free format, and network elements may either be chosen from a repertoire of available standard elements, or may be defined in one of two ways: by specifying nonlinear functions (for example, a diode may be defined by specifying the function which yields the voltage across the diode, given the current through it); or by specifying external terminals of an already-inputted network and using this nest as a new element (for example, a transistor nest may be formed by interconnecting diodes and resistors into an Ebers-Moll model). 3) Network parameters and network topology may be changed by the user through use of simple incremental commands (which specify only the information that must be changed) prior to reanalysis of the network. Author

N70-23718*# Texas Univ., Austin.

OPTIMUM SELECTION OF SYSTEM IMPLEMENTATIONS WITH A WEIGHTED SUM OBJECTIVE FUNCTION

[1969] 28 p refs

(Grant NGR-44-012-144)

(NASA-CR-109337) Avail: CFSTI CSCL 09B

The preliminary development of techniques intended to be applicable design aids in decisions concerning combination software and hardware, and pure hardware implementation of serial systems is discussed. These methods are by no means meant to be complete design methods in themselves but only to supplement existing ones. With a system to implement that is broken down into subtasks and various implementations with differing cost/performance specifications of these subtasks, a designer must choose among the implementations in order to accomplish the overall system objective as well as to optimize a chosen characteristic. This characteristic must be expressible as a weighted sum in terms of the subtasks. Two types of problems are considered, one being a subset of the other, and a specific possible application of each type is given before general formulation is made. The first problem is commonly found in computer programming while the second is an illustration of determining tradeoffs among joint hardware and software system design. Author

N70-23849 European Organization for Nuclear Research, Geneva (Switzerland).
A VERSATILE FIVE-INPUT COINCIDENCE UNIT
F. Nanni and H. Verweij 17 Dec. 1969 24 p refs
(CERN-69-31) Avail: Issuing Activity

A coincidence unit, type N6234, was designed to operate with standard NIM signal levels. A discriminator is incorporated which provides four standardized logic outputs and one standardized complementary logic output. In addition, two time overlap outputs are available. The minimum resolving time is less than or equal to 2.0 nsec. Proper functioning is guaranteed for rates up to 100 MHz via the discriminator, and up to 200 MHz via the overlap circuit. The unit is part of the CERN-NIM compatible nucleonic instrument range. Author

N70-23857# Saclant ASW Research Center, La Spezia (Italy).
LINEAR PHASE FILTERS FOR A DIGITAL DATA-ACQUISITION SYSTEM USED IN UNDERWATER SOUND PROPAGATION EXPERIMENTS
Mario Pazzini 15 Dec. 1969 28 p refs
(Saclantcen-TM-148) Avail: CFSTI

Four groups of linear-phase, low-pass filters were designed and built to couple a hydrophone array to an analog to digital conversion system. The filters are characterized by a linear phase response in the useful frequency band, a low overshoot in the step response, and a transmission loss exceeding 40 dE within the first stop-band octave. Some active circuitry was employed to eliminate insertion losses, avoid impedance matching problems, and allow the possible insertion of equalizers. Filters in the same group are phase-matched between each other within less than 0.5 importance throughout the useful frequency range. The filters are employed in a shipborne digital recording system. Author (ESRO)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N70-22544# Radio Corp. of America, Princeton, N.J. Advanced Technology Lab.
DEVELOPMENT OF HIGH POWER CW X-BAND TRANSFERRED ELECTRON OSCILLATORS Final Report, 11 May 1967 – 29 May 1969
S. Narayan, Gobat Yegna, and R. Andre Nov. 1969 83 p refs
(Contract N60921-67-C-0301)
(AD-698822) Avail: CFSTI CSCL 9/5

A research and development program on high power cw transferred electron oscillators (TEOs) in X-band is described. The objectives of the program were: (a) to obtain a power output of 500 mW, (b) a minimum operating life of 1500 hours, and (c) to design and fabricate a metal-ceramic microstrip circuit for TEOs. All these objectives were successfully met. The highest power output obtained from a single device was 700 mW at 8.75 GHz with an efficiency of 2.7%. Twenty-five devices with power outputs ranging from 50 mW to 670 mW were delivered to the contracting agency. This report describes the efforts on GaAs materials technology, device fabrication technology, and the device-circuit study. A preliminary study of the effect of second harmonic tuning on the dc/rf conversion efficiency is also described. The design criteria for a metal-ceramic microstrip circuit are discussed along with the details of fabrication of such circuits. A device on life test has logged over 16,000 hours with stable power output. Author (TAB)

N70-22564# Sylvania Electric Products, Inc., Waltham, Mass.
RELIABILITY INVESTIGATION OF CERAMIC MULTILAYER CONNECTION BOARDS Final Technical Report, Mar. 1968 – May 1969
John R. Moore and Courtney Furnival Oct. 1969 61 p refs
(Contract F30602-68-C-0243)
(AD-698339; RADC-TR-69-307) Avail: CFSTI CSCL 9/5

The report discusses the general construction techniques employed to develop a four-level, screen-printed, ceramic and glass multilayer system and the subsequent reliability testing of finished units. In the course of this investigation four ceramic multilayer construction techniques were developed and three were put through the reliability investigations. Measurement techniques for the completed multilayer are discussed, and the results of the reliability investigation for the completed units are provided. Author (TAB)

N70-22752*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Engineering Mechanics Div.
CAPSULE SYSTEM PACKAGING FOR MARS ROUGH LANDER
W. S. Read 15 Mar. 1970 25 p
(Contract NAS7-100)
(NASA-CR-109251; JPL-TR-32-1419) Avail: CFSTI CSCL 09E

The packaging techniques utilized on the Capsule System Advanced Development lander (as an experiment to determine the survivability of a Mars rough lander) are presented. The discussion covers the use of standard components, the flexibility of subsystem location, and the simple integration of electronic assemblies. The experiment conclusively demonstrates that the assembly packaging techniques utilized (conventional components) are reliable, and that the equipment is relatively easy to design and fabricate (or modify) on a short-time basis Author

N70-22757# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEWS OF INSTITUTIONS OF HIGHER LEARNING. ELECTROMECHANICS: SELECTED ARTICLES
N. V. Vlasenko et al 22 May 1969 21 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii Elektromekhanika (USSR), no. 7, 1968 p 736 – 744
(AD-696555; FTD-MT-24-122-69) Avail: CFSTI CSCL 9/1

Contents: Operation of siding electrical contacts in transformer oil; Investigation of current distribution and wear of brushes which operate in parallel in oil. TAB

N70-22762*# Radio Corp. of America, Princeton, N.J. Conversion Devices Lab.
THEORETICAL STUDY OF THE MECHANISMS OF FATIGUE IN PHOTOMULTIPLIERS PHASE 2 Final Report
Ramon U. Martinelli and George A. Morton 19 Jan. 1970 56 p refs
(Contract NAS1-8169)
(NASA-CR-66906) Avail: CFSTI CSCL 09A

The decrease in secondary emission ratio as a function of time and primary beam current density was investigated for the Cu-Be and Ag-Mg dynodes of conventional photomultipliers and for the high gain GaP dynodes. After an initial decay proportional to the charge density, the rate of decrease is approximately proportional to the logarithm of the incident charge density. From the photoelectric and gain behavior, it was concluced that both the escape depth and the escape probability are decreased by fatigue of GaP high gain secondary emitters. Circuits for overcoming the effects of fatigue by photon counting and voltage feedback with a calibrated light source are described for high first-stage gain photomultipliers used for photometry. Author

N70-22819*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OPERATIONS AND FACILITIES: FACILITY ENGINEERING
In its Space Programs Sum. No. 37-60, Vol. 2 30 Nov. 1969 p 175 – 178 (See N70-22808 10-09)
Copyright. Avail: CFSTI CSCL 09E

The emergency power subsystem progress at the Space Flight Operations Facility is reported. The components of the uninterruptable power system are described, and test results are tabulated for input requirements, and steady state and transient

outputs. The standby power plant is scheduled for completion in January 1970, and the central supervisory monitor and control system is scheduled for completion in December 1969. N.E.N.

N70-22827# Stanford Linear Accelerator Center, Calif.
HIGH-FREQUENCY POWER SUPPLY OF THE VEPP-2 STORAGE RING [VYSOKOCHASTOTNOE PITANIE NAKOPITELYA VEPP-2]
E. I. Gorniker et al [1969] 12 p refs Transl. into ENGLISH from Inst. Nucl. Phys. Novosibirsk Preprint No. 265
(SLAC-Trans-104; Rept-265) Avail: CFSTI

The equipemnt described consists of two tuned power amplifiers, a master oscillator, and a control system. One of the amplifiers operating at a wavelength of 4 m, has a rated power of 150 kW, so that it can be used to develop a voltage of up to 300 kV across the accelerating gap, which is necessary to ensure a short bunch length. The other amplifier has a rated power of 20 kW and operates at a wavelength of 12 m. It is used to take the stored particles from three separatrices onto one. The common master oscillator and the control system ensure correct phasing of the voltages at the two frequencies. The control units stabilize the operation of the system, automate the operation of recapture, and contain feedback circuits which suppress electromechanical oscillations of the resonator. Author (NSA)

N70-22860*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT RADIO
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 71-77 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 09E

Design of transformer networks with interstate coupling of solid state amplifiers centers on the matching of solid power amplifiers at frequencies where core materials are not ideal. Evaluation of a distributed amplifier configuration in which amplifier stages are placed between input and output transmission lines showed that its inherent difficulties make it impractical for high power solid state amplifiers. Direct feedback from each amplifier to all others requires the use of extremely stable transistors with low internal feedback. G.G.

N70-22868*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELECTRONICS PARTS ENGINEERING
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 172-173 (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 09A

Life test results on a number of dual and gates established that the devices had two potential problem areas: (1) circuit susceptibility to leakage current; and (2) metallization. Analyses on catastrophically failed units indicated that failure was a function of accumulates stress rather than stress level only. G.G.

N70-22874# Standard Electrik Lorenz A. G., Stuttgart (West Germany). Zentrallabor.
CONSTRUCTIONAL AND TECHNOLOGICAL DEVELOPMENTS FOR DESIGNING ELECTRONIC UNITS [KONSTRUKTIVE UND TECHNOLOGISCHE ENTWICKLUNG VON BAUWEISEN FUER ELEKTRONISCHE BAUSTEINE]
E. Adler, R. Eckert, P. Mitsch, and G. Wolpert Sep. 1969 207 p refs In GERMAN; ENGLISH summary Sponsored by Bundeshin. fuer Wiss. Forsch.
(BMWF-FB-W-69-40) Avail: CFSTI

Methods of through-hole plating of wiring boards with copper have been further improved and the test results obtained and the reliability are explained by means of examples. The development of two types of functional units, their wiring, and the construction of a casing are described, as well as the organization and operation of an ultrasound and nailhead wirebonder. The points which are essential in the multichip circuit construction are summarized. For space systems, an operational amplifier of high gain and small dissipation has been developed. An amplifier module in hybrid design and circuit configurations for analog commutators intended for use in telemetry systems are also described. Author (ESRO)

N70-22876# State Inst. for Technical Research, Helsinki (Finland).
INVESTIGATION OF MICROWAVE INTEGRATED CIRCUITS MADE BY THIN FILM TECHNIQUE
Seppo Leppaevuori, Kaj-Erik Loefgren, and Kari Mannersalo 1969 18 p refs *Its* Ser. 2, Metal and Elec. No. 25
Avail: CFSTI

In this work MIC's made by thin film techniques on alumina substrate are investigated. The technology used and the measurements are described. Finally the measured values for values for microstrip line are compared with the calculated ones. Author

N70-22892# State Inst. for Technical Research, Helsinki (Finland).
A SCHOTTKY DIODE AND ITS BEHAVIOUR IN THE GIGAHERTZ REGION
H. K. J. Kanerva, S. Leppaevuori, and T. Stubb 1969 14 p refs *Its* Ser. 2, Metal and Elec. No. 29
Avail: CFSTI

A number of Schottky diodes have been constructed and the methods of construction are briefly described. Diode parameter measurements are summarized, and properties of the fabricated diodes in a coaxial three gigahertz mixer are reported. Author

N70-22964# State Inst. for Technical Research, Helsinki (Finland). Semiconductor Lab.
EXPLANATION OF THE PROPERTIES OF THE THIN-FILM TRANSISTOR
Ralf Graeffe (Ph.D. Thesis—Technical Univ., Ontaniomi) 1969 38 p refs *Its* Publ. No. 148
Avail: CFSTI

In this paper a new model has been developed for the mechanism of the thin-film transistor, valid in both enrichment and depletion mode. In the model it is assumed that Petritz' barrier-model is valid for the conduction mechanism in the semiconductor film. The effect of the semiconductor film thickness has been considered according to Neumark's method. The new model can explain the frequently mentioned discrepancies between the Hall mobility and the field-effect mobility in thin-film transistors. The model has been verified by measurements on depletion-type cadmium selenide thin-film transistors. Author

N70-23152# Weapons Research Establishment, Salisbury (Australia).
AN OPTIMISATION TECHNIQUE FOR A MICROWAVE DIGITAL PHASE SHIFTER CONTAINING P-I-N DIODES
K. B. Whiting Sep. 1969 35 p refs
(WRE-TN-WSD-109) Avail: CFSTI

The presence of parasitic reactive elements and the limited resistance range possessed by a practical P.I.N. structure impose restrictions on its efficiency as a switching element at microwave frequencies. A procedure is described for minimizing the phase errors and impedance mismatch in a P.I.N. diode phase shifter, which arise from the parasitic reactances. Author

N70-23436# Royal Aircraft Establishment, Farnborough (England).
DEVELOPMENT OF A HIGH SPEED SOLENOID AND DRIVE AMPLIFIER
T. Shoesmith Sep. 1969 52 p refs
(RAE-TR-69206) Copyright. Avail: CFSTI

The development of a solenoid and drive amplifier capable of rapid operation (1-2 ms) is described, suitable for operating control valves in high speed pneumatic and hydraulic servo mechanisms. Various drive amplifiers and magnetic materials were used to compare their capabilities for use in a high speed device, and a suitable battery power supply was tested. Author (ESRO)

N70-23447# Dow Chemical Co., Midland, Mich. Plastics Dept.
NEW APPROACHES TO FLUID BLOCKING
R. C. Mildner, K. F. Nacke, E. W. Veazey, and P. C. Woodland Dec. 1969 25 p refs refs Presented at 18th Intern. Wire and Cable Symp., Atlantic City, 3-5 Dec. 1969
(AD-698598) Avail: CFSTI CSCL 17/2

The influence of the filling compound on the electrical characteristics of plastic-insulated multi-pair cables was studied theoretically. It is concluded that there is a strong economic incentive to find a method of blocking these cables against ingress of moisture with a filling compound of low dielectric constant. Successive amounts of water were injected into an unfilled cable so as to reveal the mechanism by which water affects the capacitance and conductance of the cable pairs. The concept of blocking these cables by means of hollow plastic microspheres, held in a fluid or solid matrix, is next introduced. The characteristics of one type of microsphere, which is commercially available, and of some fluid hydrocarbons loaded with these microspheres are described. Tests have been made to show the influence of these filling compounds on the mechanical properties of the insulating and jacketing materials used in this class of cable. Attention is drawn to the need for more revealing test procedures so that their long-term effects can be predicted with more precision. Some technical advantages are seen to lie in the use of specific polyethylene grease compounds, both as a filling medium and as a carrier for hollow microspheres. Author (TAB)

N70-23448# Du Pont de Nemours (E.I.) and Co., Wilmington, Del. Plastics Dept.

LIFE vs VOLTAGE PERFORMANCE OF FLAT CONDUCTOR CABLES AND LIGHT WEIGHT ROUND WIRE SYSTEMS

N. J. Cotter and J. R. Perkins 1969 19 p Presented at 18th Intern. Wire and Cable Symp., Atlantic City, 3 – 5 Dec. 1969
(AD-698606) Avail: CFSTI CSCL 9/1

A study was made to arrive logically at appropriate voltage ratings for unshielded flat conductor cables and round insulated wires in air. The criterion used is corona starting at sea level and at various altitudes for single and multi-insulation systems. These idealized values depend upon the insulation thickness and dielectric constants. Observed data were in adequate agreement with the calculations. It is concluded that some existing constructions may have been rated at excessively high voltages. Author (TAB)

N70-23449# Boeing Co., Seattle, Wash. Aerospace Group.

CORONA EVALUATION OF SPACECRAFT WIRES AND CONNECTORS

W. G. Dunbar [1969] 16 p refs
(AD-698597) Avail: CFSTI CSCL 9/1

The paper presents the results of corona tests conducted to obtain criteria for selecting wire for use in unpressurized spacecraft compartments. Author (TAB)

N70-23611# International Business Machines Corp., Owego, N.Y. Electronics Systems Center.

NEW DEVELOPMENTS IN FLEXIBLE PRINTED CABLE DEVICES

Raymond A. Grueninger 1969 22 p
(AD-698596) Avail: CFSTI CSCL 9/1

The paper reviews some of the more significant developments in materials and processes used in the fabrication of flexible printed interconnection cables. Polyimide printed circuit cables are emphasized, and a typical manufacturing process sequence for cables of this type is outlined and discussed. Author (TAB)

N70-23616# Fairchild Camera and Instrument Corp., Mountain View, Calif. Semiconductor Div.

DEVELOPMENT OF RADIATION HARDENED OPERATIONAL AMPLIFIERS

John S. Mac Dougal, Kenneth R. Stafford, and Hans H. Stellrecht Oct. 1969 44 p refs
(Contract F19628-69-C-0166)
(AD-698764; AFCRL-69-0410; SR-1) Avail: CFSTI CSCL 9/5

A number of monolithic operational amplifiers were fabricated and assembled as vehicles for evaluating the relative radiation hardness of air and SiO2 isolated IC structures in eleven package variants. These devices were tested in an underground nuclear field test. A shallow, radiation hardened npn transistor process is being developed. The bulk volume of the device is being minimized while maintaining a breakdown voltage (BVsub CEO) >40 volts and an hsubFE > 10 after 3 x 10 to the 14th power n/sq cm irradiation. An initial circuit design study has been made. TAB

N70-23644# AMP, Inc., Harrisburg, Pa.

SUBMINIATURE CONNECTOR SYSTEM FOR MATCHED IMPEDANCE RIBBON-TYPE CABLE

L. S. Lightner and R. G.Harwood 1969 14 p Presented at Intern. Wire and Cable Symp., Atlantic City, 3 – 5 Dec. 1969
(AD-698624) Avail: CFSTI CSCL 9/1

The chevron-shaped contact cable connector was designed to meet three goals-maximum density, optimum ease in terminating ribbon cable and minimum signal distortion. Based on the very small pin and socket contact, which allows the .025 inches centerline of the ribbon cable to be carried through the connector, the design permits the entire termination process for a 64 conductor ribbon cable to be completed in a few minutes. Stripping, tinning, insertion and soldering are mass operations taking only seconds each for the entire cable. The terminated connector is compatible with todays and even tomorrows high frequency, high speed circuitry. In some cases the impedance mismatch encountered in a connector is less than the impedance variations normally found even in high grade transmission lines. The crosstalk from the connector section of the circuit is comparable to the crosstalk encountered in the cable and, in some cases, less. Chevron-shaped contact connectors provide not only maximum packaging density and maximum termination ease but also the maximum transfer of power from line to board. Author (TAB)

N70-23663# Rome Air Development Center, Griffiss AFB, N.Y.

PARASITIC CONSIDERATIONS IN ACTIVE RC NETWORK SYNTHESIS

Aran Chompaisal Nov. 1969 108 p refs
(AD-698757; RADC-TR-69-423) Avail: CFSTI CSCL 9/5

An analysis was made of the error in Deitzhold realization technique. This error in the transfer function is introduced by the finite values of transconductance, input and output impedances of the actual amplifier used in the realization scheme. The error introduced by the transconductance above is considered first, and then the error introduced by all three parameters mentioned above are considered together emphasizing in each case how to limit the error to within ten percent of the given transfer function. In this procedure, some general results regarding the relationships between the magnitude of the error and the positions of zeros and poles of the given transfer function are also found. Author (TAB)

N70-23691# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

WAVEGUIDE OR SPHEROIDAL CAVITY COUPLINGS TO A NONLINEAR ELEMENT WITH LOCALIZED CONSTANTS OF THE TUNNEL DIODE TYPE [COUPLAGE D'UN GUIDE OU D'UNE CAVITE SPHEROIDALE A UN ELEMENT NON LINEAIRE A CONSTANTS LOCALISEES DU TYPE DIODE TUNNEL]

Edouard Rivier Dec. 1969 29 p Transl. into ENGLISH from Grenoble Univ. (France) publ., 1968 16 p Prepared for Lincoln Lab., MIT
(AZT-69-607-FRLL) Avail: CFSTI

Structures permitting coupling of a tunnel diode and a waveguide are described, and the circuit which, upon leaving the diode, is connected to the continous charge is studied. The coupling coefficient of a loop, damping of the diode line by the cavity, frequency removal of the diode line by the cavity, loop self-inductions, diode capacities, coupling on a harmonic, and deviation of measurement due to monolinearities were studied. Multidiode setups and problems posed by them are also described. Electric coupling between oscillators with several diodes and a spheroidal cavity is discussed, and details on the problem of synchronism are given. N.E.N.

N70-23695# Aztec School of Languages, Inc., Maynard, Mass.

CERTAIN TEMPERATURE PROBLEMS IN THE DESIGN AND

CONSTRUCTION OF LARGE-SCALE ANTENNAS [EINIGE TEMPERATURPROBLEME BEI ENTWURF UND BAU VON GOSSANTENNEN]
W. Schoenbach Dec. 1969 17 p refs Transl. into ENGLISH from der Stahlbau, No. 12, 1968 p 1–4 Prepared for Lincoln Lab., MIT
(AZT-69-640-GELL) Avail: CFSTI

The effects of uniform temperature changes upon antennas composed of one or more metals (specifically, steel and aluminum) and their determination by means of mathematical calculations are studied, using the example of three large scale antennas. Results indicate that even uniform temperature changes can lead to considerable deformation, regardless of whether the antenna is of uniform or composite construction. Author

N70-23731# Microwave Associates, Inc., Burlington, Mass.
DESIGN, DEVELOP, AND FABRICATE A MECHANICALLY TUNABLE, POSITIVELY PULSED GROUNDED CATHODE MAGNETRON Final Report, 15 Jun. 1968 – 15 Jul. 1969
Richard S. Briggs 15 Aug. 1969 43 p
(Contract F19628-68-C-0355)
(AD-698351; AFCRL-69-0488) Avail: CFSTI CSCL 9/1

The general features of the tube design were: low power, small size, positive pulse, and tunability. A rising sun anode in preference to strapped or coaxial anodes was used to provide the electrical and mechanical requirements for operation at 36 GHz. Problems were encountered with tooling and frequency control. A replaceable cathode design featuring a Philips dispenser type was used. Larger diameter cathodes were used in later tubes to provide improved operation. The output system consiting of a transformer, window, and output flange was evolved to meet mechanical and electrical requirements. Problems were encountered with accurate cold tests and with parameters required for optimum coupling. The inductive internal tuner was modified to reduce losses. Tuning settability to within 2 MHz was provided. The use of Alnico 9 magnets provided a compact, lightweight design. Assembly techniques and processing procedures were evolved, such as cathode centering, cathode replacement, pulse aging with a Vac-Ion pump, and magnet charging. A ruggedized magnetron package was evolved. Test results of five magnetrons were evaluated and related to work done with the output system, tuner, frequency range, cathode, and V-I characteristic. The MA 275 program provided, in addition to usable tubes, a prototype design for the manufacture of small, low power, tunable magnetrons in the 36 MHz regions. Author (TAB)

N70-23746# National Bureau of Standards, Washington, D.C. Electronic Technology Div.
TABULATION OF DATA ON SEMICONDUCTOR AMPLIFIERS AND OSCILLATORS AT MICROWAVE FREQUENCIES
Charles P. Marsden and Rita Y. Cowan Feb. 1970 67 p
(NBS-TN-518) Avail: SOD $0.65

This tabulation includes some of the basic characteristics of semiconductor microwave devices, specifically amplifiers and oscillators of foreign and domestic origin. Author

N70-23821# Leasco Systems and Research Co., Ltd., London (England).
ESRO DATABANK PROJECT: FEASIBILITY STUDY REPORT ON THE DESIGN OF A DATABANK (ELECTRONIC COMPONENTS AND MATERIALS)
Paris ESRO Apr. 1969 199 p Prepared for ESRO
(Contract ESTEC-615/68-RS)
(ESRO-CR-11) Avail: CFSTI

The results of a preliminary feasibility study into the concept of a databank of electronic component product and test data are reported. The work was carried out during the first quarter of 1969. Data input would be of two kinds: descriptive product data obtained from component manufacturers, and component test data received from approved testing authorities including homologation or type approval data and failure rate data. Output would include an SDI (selective dissemination available. information) service on new components and on-line interrogation of the master file. Both the automated systems and the supporting manual procedures necessary are outlined including: a classification scheme for electronic components; the functions of the data preparation unit; and the computer programs for data validation; selective dissemination, file maintenance, on-line interrogation, and auxiliary routines. ESRO

N70-23838# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
THE 'SOLENOID': A DEVICE FOR GENERATING HIGH-INTENSITY MAGNETIC FIELDS [USTANOVKA 'SOLENOID' DLYA POLUCHENIYA SVERKHSILNYKH MAGNITNYKH POLEY]
V. G. Veselago et al Sep. 1969 11 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 12, 1968 p 58–62 Prepared for Lincoln Lab., MIT
(AZT-69-594-RULL) Avail: CFSTI

An instrument is described that can be used to generate high-intensity magnetic fields. Both cooled and superconducting solenoids are discussed and the cooled solenoids are favored due to their higher kOe. Author

N70-23850 National Lending Library for Science and Technology, Boston Spa (England).
ELECTRONIC PROTECTION INSTALLATIONS IN PLUG-IN UNIT TECHNIQUES [ELEKTRONISCHE SCHUTZEINRICHTUNGEN IN EINSCHUBTECHNIK]
Erwin Zurowski 21 Nov. 1969 10 p Transl. into ENGLISH from Siemens-Z. (Erlangen), v. 43, no. 4 p 379–381 In GERMAN and ENGLISH
(NLL-EE-Trans-1909-(3774.5)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupons

A plug-in technique is described which is used for the protection of electrical machines and power systems. The machine protection consists of a series of large and small modules whose static and relay outputs are applied to the corresponding trip and alarm devices through a diode matrix. Plug connections, trip circuits, and actuating voltages are checked and the processing of the measured values in the individual modules are verified by means of a build-in test system. J.M.C.

N70-23881# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).
LINEAR GATE WITH CAPACITIVE LOAD [LINEARES TOR MIT KAPAZITIVER LAST]
K. Kriescher Jun. 1969 44 p refs In GERMAN
(Contract T-932-I-203)
(RR-4-69) Avail: CFSTI

A holding circuit was designed and its charging and discharging times were studied. Various parameters e.g. circuit linearity, maximum and minimum allowable charging times were investigated and the most useful circuit appeared to be a gate with capacitive load. The static and dynamic performances were examined and appropriate dimensions were used. The final circuit was a linear gate with several parallel transistor pairs. ESRO

N70-23885# Washington Univ., St. Louis, Mo. Dept. of Electrical Engineering.
THEORETICAL INVESTIGATION OF THE PERFORMANCE OF A-C MACHINES Final Report, Feb. 1968 – Sep. 1969
R. J. W. Koopman Sep. 1969 188 p refs
(Contract DAAK02-68-C-0302)
(AD-699363) Avail: CFSTI CSCL 9/3

The dynamic performance of a three-phase induction motor is analyzed on a digital computer using a mathematical model proposed by Robertson and Hebbar which gives stator currents without transformation to a new set of axes. Various conditions of operation are analyzed, including unbalance, opening and reclosing of a line, and inputs with high time harmonic content. These capabilities make the method attractive for use in the dynamic analysis of automotive systems using electronic power supplies for

induction motor drives. The effect of space harmonics was analyzed by the direct method in which neither rotor nor stator currents are transformed. Because of the difficult computation process involved, the analysis including space harmonics had to be limited to those dynamic cases in which either constant acceleration or constant speed was prescribed. It is suggested that further study be directed toward the effects of space harmonics. Author (TAB)

N70-23893# Naval Ordnance Lab., White Oak, Md.
A CLIPPER AMPLIFIER USING INTEGRATED CIRCUITS
Arthur D. Delagrange 14 Aug. 1969 16 p
(AD-699137; NOLTR-69-140) Avail: CFSTI CSCL 9/5

The report describes a new circuit for a clipper amplifier, a device which amplifies and limits an analog signal, preserving only the sign or polarity of the input. The new circuit overcomes some of the limitations of previous clipper circuits. The circuit utilizes integrated-circuit operational amplifiers as the gain elements, with a unique feedback arrangement to negate the undesirable characteristics of the integrated circuits. The clipper is designed for a frequency range of 10 Hz - 10 kHz and an input amplitude range of 100 micro Vrms - 10 Vrms at midband frequency. Input impedance is 10Kohm AC coupled. Equivalent input noise is about 3.0 micro Vrms. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N70-22514# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHESIS OF ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITRY BASED ON INERTIAL AND PRIMITIVE SUBCIRCUITS
E. A. Yakubaitis 6 Aug. 1969 23 p ref Transl. into ENGLISH from Adaptive Control Systems (Moscow), 1967 p 304-313
(AD-698536; FTD-MT-24-153-69) Avail: CFSTI CSCL 9/5

The synthesis of a sequential circuit that performs specified transformations under both static and dynamic conditions is considered. A table of steps is worked out. In most cases, simplifications that reduce the circuit cost are possible. Hazardous contests in the logic circuit can be precluded by introducing either special filters or structural redundancy. An example of synthesizing a sequential circuit from NOR or stable elements illustrates the method. TAB

N70-22793# Iowa Univ., Iowa City. Dept. of Mechanical Engineering.
DESIGN OF LINEAR TIME INVARIANT CONTROL SYSTEMS
Y. L. Wu and G. M. Lance Dec. 1969 24 p refs
(Contract DAAF03-69-C-0014; Proj. Themis)
(AD-698845; THEMIS-UI-15) Avail: CFSTI CSCL 12/1

Although a great deal has been written recently concerning the design of nonlinear systems, time varying systems and multivariable systems, it is still a fact that there are no completely satisfactory methods available for the design of linear, time invariant, single input-single output systems. Two areas of difficulty are the choice of suitable specifications on system response and methods for choosing system parameters to meet as nearly as practicable the chosen specifications. If the system being considered is second order or dominant second order, classical procedures are quite adequate. However, for higher order systems, even though there is no real difficulty from an analysis point of view, a large amount of trial and error can be involved. This report presents a method for choosing system parameters so that a reasonable match between the system response and a simplified desired response is achieved. The parameters are determined by equating Laplace transforms of the system response and the desired response at an appropriate number of values of the Laplace variable, s, and solving for the parameters. Author (TAB)

N70-22794# State Univ. of New York, Stony Brook. Dept. of Electrical Sciences.
CONTROL SYSTEMS Interim Scientific Report, 2 Oct. 1968 -1 Oct. 1969
Sheldon S. L. Chang Oct. 1969 16 p refs
(Grant AF-AFOSR-542-67)
(AD-698854; AFOSR-69-3044TR) Avail: CFSTI CSCL 12/1

Publications in the current year cover a broad front in control systems theory: optimal control, stochastic game theory, learning and adaptive algorithm, and estimation and control in the presence of triangular noise. Perhaps worthy of special mentioning here is the concept of Fuzzy Dynamic Programming. It is an extension of the dynamic programming idea to take into account the following factors: incompletely known process, the varying degree of risk, and the many valued or vector return function. When fuzzy dynamic programming is applied to control systems with incompletely known or changing dynamics, it is considerably simpler than minimizing the sensitivity function, and yields a globaly good closed-loop control. It also furnishes a link between dynamic programming and Lyapunov stability theory. Current work in progress on fuzzy dynamic programming is aimed at developing computer algorithm for obtaining the guaranteed cost function (or guaranteed cost matrix for linear systems), and also to apply it to learning and adaptive systems. Author (TAB)

N70-22987# Royal Aircraft Establishment, Farnborough (England).
AN OPTIMUM DESIGN OF A WIDEBAND SERVOMECHANISM TO CONTROL THE SHAFT VELOCITY OF A PRINTED-ARMATURE MOTOR
J. W. King Nov. 1969 35 p refs
(RAE-TR-69235) Copyright. Avail: CFSTI

The report describes how a printed-armature motor can be driven over a wide range of controlled shaft velocity in a phase-locked servomechanism providing the maximum ratio of low-frequency accuracy to high-frequency noise. The servomechanism bandwidth is so extended as to allow a reduction in the inertial load. A description of a practical servomechanism is included. Author (ESRO)

N70-23028# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
CASE FOR ADAPTIVE CONTROL
M. A. Ostgaard *In* AGARD Advanced Control System Concepts Jan. 1970 p 13-27 (See N70-22026 10-21)
Avail: CFSTI

The factors that influence the choice and selection of feedback parameters, the role adaptive techniques play in designs, and some benefits available from adaptive techniques are discussed. Two methods were established for controlling closed loop characteristics; limited bandwidth was also considered. Time response requirements, dynamic network element design, identification techniques, design considerations, sample design, and identification problem are also given. J.A.M.

N70-23029# Massachusetts Inst. of Tech., Cambridge.
THEORETICAL PERSPECTIVE OF ADAPTIVE CONTROL TECHNIQUES AND MODERN CONTROL THEORY
Herman A. Rediess *In* AGARD Advanced Control System Concepts Jan. 1970 p 29-38 refs (See N70-22026 10-21)
Avail: CFSTI

The theoretical perspective of the adaptive techniques and the other distinct control principles generally associated with modern control theory are summarized briefly. Author

N70-23030# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fur Flugfuhrung.
PRIMARY FLIGHT CONTROL CIRCUIT DEVELOPMENT FROM MECHANICAL SYSTEMS TO AN ALL-ELECTRIC

DIGITAL SIGNALING SYSTEM
K. H. Doetsch and W. Metzdorff *In* AGARD Advanced Control System Concepts Jan. 1970 p 41–47 refs (See N70-23026 10-21)
Avail: CFSTI

Mechanical control operation is summarized, including mechanical control circuit development, present position on mechanically operated control systems, electrical signaling system comparison, and intermediate solutions. Reliability considerations are also reviewed, consisting of mechanical primary flight controls, reliability and confidence level of fly-by-wire systems, mechanical backup system and maintainance model for electronic part of the fly-by-wire systems, in-flight repair of function and failure detection subsystems. Feasibility, analogue/digital and digital/analogue conversion function location, digital/analogue converter and mechanical feedback in the electro-hydraulic servo system, failure detection, and in-flight tests were discussed, related to digital fly-by-wire system realization. J.A.M.

N70-23415# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Mathematics.
STUDIES IN CONTROL THEORY AND NONLINEAR MECHANICS Final Report, 1 Feb. 1966 –31 Aug. 1969
Bernard A. Fleishman 31 Aug. 1969 7 p refs
(Contract AF 49(638)-1661)
(AD-698786; AFOSR-69-3072TR) Avail: CFSTI CSCL 12/1

The original object of this research project was to study oscillations in nonlinear systems, with special interest in discontinuous systems (of a type which occur frequently in control technology). While activity has been undertaken also in related areas, we have remained interested in discontinuous differential (and integral) equations. A second broad area of our research has been concerned with positive solutions and comparison theorems for nonlinear (differential, integral or function) equations. An investigation has been carried out for the Cauchy problem and time-periodic solutions of a family of nonlinear wave equations. Author (TAB)

N70-23696# Aztec School of Languages, Inc., Maynard, Mass.
SYNTHESIS OF ACTIVE FILTERS WITH ELLIPTICAL CURVES [SYNTHESE DES FILTRES ACTIFS A CARACTERISTIQUE ELLIPTIQUE]
M. Bogdanov et al Dec. 1969 35 p refs Transl. into ENGLISH from Revue H. F., v. 6, no. 8, 1965 p 245–258 Prepared for Lincoln Lab., MIT
(AZT-69-635-FRLL) Avail: CFSTI

Various structures of active filters are studied and compared from the point of view of performance and stability; the original solution suggested permits the synthesis of filters with elliptical characteristics by means of negative impedances, the latter being obtained using operational amplifiers with integrated circuits. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N70-22580# Ion Physics Corp., Burlington, Mass.
AFCRL FACILITIES OPERATION Final Report, 15 Jul. 1967 –15 Jul. 1969
Roger Little and Jerome Friedman Dec. 1969 75 p refs
(Contract F19628-67-C-0279)
(AD-698354; AFCRL-69-0469) Avail: CFSTI CSCL 20/7

Two PIN diode detectors were developed for monitoring bremsstrahlung and electron radiation environments. The detectors were calibrated against LiF thermoluminescent dosimeters (TLD). A lithium drifted detector was assembled for gamma ray spectroscopy. The system was calibrated with isotopes of Co57 and Ba133 and found to have a resolution of 20 keV in the 50 to 100 keV range. Bremsstrahlung radiation production from the AFCRL linear accelerator as a function of tungsten target thickness was studied with TLDs. Maximum on-axis dose at one meter was obtained with a 0.030 inch thick target which agrees with the predicted optimum converter thickness. Using a PIN diode detector system, bremsstrahlung field maps were obtained for several target thicknesses. The linear accelerator 10 MeV electron beam was mapped with both TLDs and a PIN diode detector. Several modifications to the AFCRL LINAC we were accomplished. These included a remote trigger, a permanent cable run, an external bremsstrahlung converter, a beam stopper and a rotating wheel sample holder. The latter, when equipped with various foils and a PIN diode detector, can be used to make electron beam range measurements. Author (TAB)

N70-22696# National Accelerator Lab., Batavia, Ill.
THE 200-GeV ACCELERATOR OF THE NATIONAL ACCELERATOR LABORATORY Progress Report
Lincoln A. Read Aug. 1969 38 p Presented at the High Energy Phys. Conf., Boulder, Colo., 18-23 Aug. 1969
(Contract AT(49-8)-3000)
(NAL-32; CONF-690813-6) Avail: CFSTI

A review of the principal design features of the 200-GeV accelerator and of the laboratory facilities to be built at the accelerator site, a review of the current status of the design and construction work on the various component subaccelerators which comprise the 200-GeV accelerator, and a brief discussion of the plans which are being developed for experimental facilities and high-energy physics research at NAL are presented. Author (NSA)

N70-22766# Battelle-Northwest, Richland, Wash.
SURVEY OF TRANSPORT METHODS FOR SHORT TERM IRRADIATION FACILITIES
M. K. Mahaffey Oct. 1969 33 p refs
(Contract AT(45-1)-1830)
(BNWL-1215) Avail: CFSTI

Methods and systems for achieving short term irradiations in test reactors are reported. Systems discussed include pneumatic facilities for fast operation, quick handling, and low cost; hydraulic rabbits for accommodating higher heat generation rates, or higher induced activities; and trail cables for accommodating larger heavier test assemblies while maintaining instrumentation and monitoring. Other hybrid facilities are also described. Probable modifications and problem areas which would be encountered in adapting the above principles to the Fast Flux Test Facility are also discussed. Author (NSA)

N70-22782# Stanford Linear Accelerator Center, Calif.
ACCELERATING RESONATOR FOR THE VEPP-2 STORAGE RING [USKORYAUSHCHII REZONATOR NAKOPITELYA VEPP-2]
V. G. Veshcherevich et al [1969] 12 p refs Transl. into ENGLISH from Inst. Nucl. Phys. Novosibirsk Preprint No. 272, 1969, 10 p
(SLAC-Trans-103; Rept-272) Avail: CFSTI

The resonator of the VEPP-2 storage ring operates in two oscillation modes: the antiphase mode (natural frequency 75 MHz, shunt resistance about 1 Mohm) and in the inphase mode (natural frequency 25 MHz, effective shunt resistance about 7.5 kohm). The operating accelerating voltage of up to 300 kV at the third harmonic of the rotational frequency is ensured by the first mode. The second mode is used to recapture the particles from three separatrices onto one. Full account is taken in the resonator design of the required spectrum of higher natural frequencies, so that coherent synchrotron and beatron oscillations are adequately damped out. Author (NSA)

N70-22913*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala.
PROGRAM SUPPORT

In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 28 p refs (See N70-22901 10-31)
Avail: CFSTI CSCL 22D

The HEAO-A program was analyzed to identify the major elements of program support and to establish an approach and basis for further study. The areas of program support requirements identified are discussed and include ground support equipment, test facilities, reliability and quality assurance, safety, logistics, manufacturing, and testing. Author

N70-23044# State Inst. for Technical Research, Helsinki (Finland).
SURVEY OF THE SKID RESISTANCE PROPERTIES OF ASPHALT SURFACINGS [TUTKIMUKSIA ASFALTTIPAEAELLYSTEIDEN KITKAOMINAISUUKSISTA]
J. M. I. Hyyppae 1969 56 p refs In FINNISH and ENGLISH
(PUBL-141) Avail: CFSTI

Tests were made of the skid-resistance properties of asphalt surfacings by the application of a light trailer apparatus. Road sections at least one year in age were measured in regard to their skid-resistance properties, the effect of type tread pattern and studs upon the coefficient of friction, and the effect and significance of the wearing induced by sanding material and traffic upon the coefficient of friction. Measurements were effected at speeds of 50, 70, and 90 k.p.h. The results obtained indicate that with a few exceptions the skid-resistance values are fairly good. It was found that the tire-tread pattern, the studding, and also the grain size of sanding material considerably affected the value of the coefficient of friction; similarly, it is changed essentially by the wearing resulting from traffic. Author

N70-23287*# Batelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF A SINUSOIDAL PRESSURE GENERATOR FOR PRESSURE TRANSDUCER DYNAMIC CALIBRATION Interim Report, Jun. 1968 – Aug. 1969
Richard E. Robinson 25 Mar. 1970 43 p refs
(Contract NAS3-11229)
(NASA-CR-72656) Avail: CFSTI CSCL 14B

The purpose of this effort was to develop a new sinusoidal pressure generator for use in the dynamic calibration of pressure transducers and to evaluate the performance of the device. Evaluation tests were conducted using two different performance settings at chamber pressures up to 300 psia and over a frequency range of 1-15 kHz. Specified oscillation pressure amplitude performance was exceeded by 50 percent. Excellent agreement between the theoretically predicted pressures and those obtained experimentally was found. It was concluded that the unit is suitable for dynamic response evaluation of pressure sensing systems over a wide range of pressure levels, amplitudes, and frequency. Author

N70-23341# National Physical Lab., Teddington (England). Metrology Centre.
RECOMMENDATIONS FOR THE DESIGN AND EQUIPPING OF ENGINEERING METROLOGY LABORATORIES
T. R. J. Oakley Jan. 1970 22 p refs
(NPL-MC-4) Copyright. Avail: CFSTI

This general guide gives suggestions on size, site, general design features, atmospheric control, equipment, and other factors that affect the satisfactory functioning of an engineering metrology laboratory. A bibliography and a list of some suppliers of equipment are included. Author (ESRO)

N70-23352# Fraunhofer Institut, Freiburg (West Germany).
THEORETICAL INVESTIGATIONS OF THE OPERATION OF A SOLID ROCKET SHOCK TUBE [THEORETISCHE UNTERSUCHUNGEN ZUM BETRIEB EINES STOSSWELLENROHRES MIT FESTSTOFFRAKETEN]
G. Schwarzkopf May 1969 31 p refs In GERMAN
(Rept-2-69) Avail: CFSTI

The use of solid propellant rockets in shock wave simulators is discussed and the shock waves to be expected for different tube cross-sections using a specific type of rocket are evaluated numerically. Some difficulties arise with short tubes and very strong shocks which indicates the desirability of using long tubes and weather shocks. ESRO

N70-23371# Fraunhofer Institut, Freiburg (West Germany).
SCHLIEREN-OPTICAL INVESTIGATIONS WITH AN AEROBALLISTIC TEST STAND [SCHLIEREN-OPTISCHE UNTERSUCHUNGEN IN DER AEROBALLISTISCHEN ANLAGE]
H. Giesbrecht, W. Merzkirch, and A. Stile Jun. 1969 21 p refs In GERMAN
(Rept-4-69) Avail: CFSTI

A new optical system is described which has been used to trigger a high speed schlieren camera and a light gas gun with increased resolution and accuracy. Several optical paths for schlieren photography were tested and an interesting phenomenon, arising from the reflection of the bow wave at the channel wall, was found. ESRO

N70-23408# European Space Research and Technology Center, Noordwijk (Netherlands).
EXPERIMENTAL RESULTS OF RADIATION FLUX MEASUREMENTS CARRIED OUT IN THE ESTEC HBF 3
M. Janes and B. C. M. Aalders Dec. 1968 36 p refs
(ESRO-TN-34-ESTEC) Avail: CFSTI

Tests were carried out on 7 August 1967 and 10 January 1968 in the ESTEC Heat Balance Facility HBF 3, in which various fluxmeters were installed. The first aim was to determine the radiation intensity in the reference plane of the chamber. The second aim was the calibration of different types of fluxmeter under chamber conditions. In order to obtain a range of intensity levels, the lamps of the solar simulator were switched on step by step. With all lamps in operation, different power levels were obtained by running at minimum, normal, and maximum power settings. This mode of operation was also used for the second test. A brief description is given of the test procedure, including tabulation of the time schedules. The results of the tests are given in tables and graphs. Author (ESRO)

N70-23532*# National Bureau of Standards, Washington, D.C. Electronic Technology Div.
ACCELEROMETER CALIBRATION WITH THE EARTH'S FIELD DYNAMIC CALIBRATOR
John S. Hilten Mar. 1970 30 p refs Sponsored in part by NASA, Army, Navy, and Air Force
(NASA-CR-109287; NBS-TN-517) Avail: SOD $0.35; CFSTI CSCL 14B

A simple device for the precise dynamic calibration of certain accelerometers at low frequencies is described. Calibration of an accelerometer is achieved by rotating the instrument in earth's gravitational field at a number of constant rotational speeds. Author

N70-23636 Polytechnic Inst. of Brooklyn, N.Y.
MERGED LAYER FLOW IN AN INTERIOR CORNER
Edward M. Schmidt (Ph.D. Thesis) 1969 182 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-20362

The development of a wind tunnel facility to provide low density, high Mach number gas flows is described. The method to generate such flows is through a secondary expansion of an already hypersonic free stream. This expansion establishes a flow within the secondary nozzle having free stream conditions. A data acquisition technique is proposed. Pitot pressure and hot wire probes are used as the basic flow survey tools. A method of hot wire anemometry applicable to short length, cold support probes is developed using analytical and experimental results. The technique allows for operation at mean wire temperatures below the recovery temperature thereby providing good sensitivity without the problems associated with high wire temperatures. A data reduction procedure is described which accounts for the effect of low density flows upon the measurements of both the hot wire and pitot probes. Dissert. Abstr.

N70-23638# Watervliet Arsenal, N.Y.
HIGH TEMPERATURE FATIGUE TEST SYSTEM Technical Report
Bruce B. Brown Oct. 1969 45 p refs
(AD-698463; WVT-6914) Avail: CFSTI CSCL 14/2

A laboratory fatigue test system has been developed to allow testing of thin-walled cylinders of varying geometry and material at elevated temperatures under conditions of cyclic internal pressure. The system has a pressure limit of 10,000 psi, a temperature limit of 1500F, and utilizes specimens with a 3.205 inch bore diameter. Author (TAB)

N70-23705# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme
THE SATELLITE ATTITUDE SIMULATOR OF THE DFVLR IN OBERPFAFFENHOFEN [DER SATELLITENBEWEGUNGSSIMULATOR DER DFVLR IN OBERPFAFFENHOFEN]
Albert Roelker Nov. 1969 41 p refs In GERMAN; ENGLISH summary
(DLR-MITT-69-20) Avail: CFSTI

The mechanical structure of the DFVLR satellite attitude simulator and its coordinated instruments are described. The disturbing torques influencing the simulator were investigated, and a method to reduce these torques is described. Author (ESRO)

N70-23720# Federal Aviation Agency, Washington, D.C.
RUNWAY TRACTION
R. C. McGuire 17 Jun. 1969 5 p
Avail: CFSTI

Work to improve operational safety on slippery runways is on schedule. The development and implementation of grooved runway technology at major airports is continuing. The work leading to the development of a method by which runway friction measurements can be correlated with aircraft stopping distance is in process, and it is hoped that a trial method can be offered to industry within the next twelve months. Author

N70-23743# British Aircraft Corp., Preston (England).
A SIMULATOR INVESTIGATION OF ROLLING REQUIREMENTS FOR LANDING APPROACH
A. G. Barnes London HMSO 1969 39 p refs Supersedes VAC-Ae-280; ARC-30435
(ARC-R/M-3605; BAC-Ae-280; ARC-30435) Copyright. Avail: CFSTI

This report describes a fixed-base simulator investigation of the rolling requirements for two types of aircraft on the landing approach. A small trainer/strike aircraft, and a large transport aircraft were simulated, and pilot opinion was obtained for differing values of damping in roll, and the maximum rolling acceleration for full aileron. The results are compared both with existing handling criteria, and also with known aircraft. Author (ESRO)

N70-23758# Royal Aircraft Establishment, Farnborough (England). Materials Dept.
AN INVESTIGATION OF THE MEANS OF ARRESTING A ROCKET PROPELLED VEHICLE TRAVELLING AT 1000 FT/S
R. B. King and T. G. Randall Mar. 1969 31 p refs Prepared jointly with RAE, Bedford, Naval Air Dept.
(RAE-TR-69047) Copyright. Avail: CFSTI

An investigation was made of the possibility, should the retrorocket fail, of arresting a rocket propelled vehicle travelling at 1000 ft/sec. The evaluation was undertaken on the high speed test track. The main study was confined to the use of nylon materials as part of an arrester system, but alternatives were considered. It was found that a conventional system using nylon could not be guaranteed to operate in the required velocity range but would be ideal at lower speeds. An aerodynamic decelerator was feasible, but if actuated by electrical means it would suffer from the same disadvantages as retrorockets. A system using a linear motor would be ideal for a new track but was rejected on economic grounds for the present one. The other schemes were considered impractical in the present context. Author (ESRO)

N70-23794# Bureau of Mines, Amarillo, Tex. Helium Research Center.
ELASTIC PRESSURE DISTORTION OF THE VOLUMES OF A 1000-ATMOSPHERE BURNETT COMPRESSIBILITY APPARATUS OVER THE TEMPERATURE RANGE 0 TO 75 C
Ted C. Briggs and Alvin R. Howard Apr. 1970 26 p refs
(BM-RI-26) Avail: Issuing Activity

A removable-jacket distortion apparatus was constructed and used to measure distortion coefficients for two high-pressure vessels. The measured distortion coefficients were used to compute distortion coefficients for volumes of a 1000-atmosphere Burnett compressibility apparatus for the temperature range 0 to 75 C. Young's modulus for Armco 17-4 PH stainless steel, heat treated to condition H1150-M, was computed from experimentally determined distortion coefficients. A 10- to 14-percent correction to the values obtained for Young's modulus may be required because pressure vessel end effects were neglected. The distortion coefficients of the compressibility apparatus are believed to be accurate to about 1 percent. Author

N70-23883# Technische Univ., Berlin (West Germany). Inst. fuer Flugfuehrung und Luftverkehr.
DETERMINATION OF STARTING AND LANDING RUNWAY LENGTHS FOR AIRCRAFT PLANNING: OPERATIONAL, NAVIGATIONAL, AND FLIGHT SAFETY PRINCIPLES [BESTIMMUNG VON START- UND LANDEBAHNLAENCEN BEI DER FLUGHAFENPLANUNG: BETRIEBSTECHNISCHE, NAVIGATORISCHE UND FLUGSICHERUNGSTECHNISCHE GRUNDLAGEN]
Edgar Roessger and Hans-Edgar Kallies Jun. 1968 42 p refs In GERMAN Presented at the Seminar on Airport Design, Berlin, 5 Feb. 1968
(Rept-47) Avail: CFSTI

A survey is given of the development of airport planning and the principal parameters to be considered in airport design are discussed: e.g. aircraft characteristics, airport altitude, runway conditions, runway direction, and wind conditions. Graphs are provided for the calculation of runway length considering these parameters. ESRO

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N70-22575# Sandia Corp., Albuquerque, N. Mex.
DETERMINATION OF THE GRUNEISEN COEFFICIENT AS A FUNCTION OF THE SPECIFIC VOLUME BY MEANS OF STUDYING THE REFLECTION PHENOMENON OF MACH
J. Leygonie et al. 14 Nov. 1969 16 p refs Transl. into ENGLISH from the French Presented at the Intern. Symp. on Behavior of Dense Media Under High Pressures, Paris, 11-15 Sep. 1967 p 161-172
(PB-187942) Avail: CFSTI CSCL 20K

The study is concerned with the reflection of shock waves in dense metallic media. Although certain aspects of the problem are common to both dense and gaseous media, the only analysis that would be applicable to gaseous media is that shown here. Author (USGRDR)

N70-22605 Lehigh Univ., Bethlehem, Pa.
AN AIR-WATER STUDY OF VERTICAL UPWARD AND DOWNWARD TWO-PHASE FLOW

Lawrence Peter Golan (Ph.D. Thesis) 1968 153 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-7335

An investigation of the hydrodynamic differences between vertical upward and downward two-phase air-water flow has been completed. The investigation was principally concerned with the differences in flow patterns void fractions, and pressure drops. The first flow map for vertical downward flow is presented. This vertical downward flow map is divided into three flow regions of annular, oscillatory, and slug and bubble flow. The predominant flow regime in downward flow was found to be annular with the liquid on the tube wall. A vertical up flow map has been obtained which is the first complete flow map for this direction of flow. The annular-froth and slug-froth flow regime transitions are represented by non-dimensional transition equations of the Griffith form. A comparison of these two maps shows that significant differences exist between vertical upward and downward flow. The downward flow map indicates that at low air/water volume ratios a high voidage annular flow may occur. Dissert. Abstr.

N70-22639 Purdue Univ., Lafayette, Ind.
SIMILARITY STUDIES OF DISCHARGE OF LIQUIDS FROM CONTAINERS THROUGH ORIFICES AND TUBES
Achuth Ramayya Mulukutla (Ph.D. Thesis) 1968 216 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 69-7483

The investigation was conducted with special attention to the development of proper scaling procedures and similarity relationships. Analyses based on one-dimensional flow models yielded functional relationships for the dependence of the dimensionless mass flow rate on the other pertinent parameters obtained from dimensional analysis. Analyses based on the assumption of quasi-steady flow, and neglecting inertia effects, yielded simple mathematical solutions which were readily evaluated. However, these solutions become inaccurate as the ratio of the container cross-sectional area to the discharge area is decreased. Improved analyses, which properly account for inertia effects, yielded second order nonlinear differential equations describing the dynamics of the process. Finally, experiments were conducted in ranges where the inertia effects were significant using two different entrance geometries for the discharge tube entrance (rounded and sharp-edged entrance). Dissert. Abstr.

N70-22700 Rutgers Univ., New Brunswick, N.J.
THE STABILITY OF VISCOUS TIME-DEPENDENT FLOW BETWEEN CONCENTRIC ROTATING CYLINDERS WITH A WIDE GAP
Robert P. Kirchner (Ph.D. Thesis) 1968 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-7555

The stability of the time-dependent rotational Couette flow, induced by an impulsively started inner cylinder, was experimentally and theoretically investigated. A 1/2-inch O.D. cylinder was rotated concentrically in a 5-inch I.D. cylinder. The space between the cylinders was filled with distilled water. The time-dependent instabilities were observed by means of dye injection. They appeared as a series of disks spaced evenly along the inner cylinder. The spacing and growth of these instabilities were recorded using a motion picture camera. From the motion pictures the critical time (time from impulsive start to the first onset of instability) and spacing of the instabilities were experimentally determined and a marginal stability curve (Reynolds number versus critical time) was constructed. A theoretical investigation was made using a normal mode analysis of the linearized disturbance equations. The quasi-steady and momentary stability approaches were used to theoretically predict the neutral stability curve. Dissert. Abstr.

N70-22730 Rensselaer Polytechnic Inst., Troy, N.Y.
AN INVESTIGATION OF THE WALL EFFECT IN THE LAMINAR FLOW OF SOME POLYMER SOLUTIONS
Gerhard John Reusswig (Ph.D. Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-6474

Because of several previous reports of flow anomalies in the laminar capillary flow of macromolecular solutions, and the general friction reduction activity in turbulent flow, an experiment was devised to check directly the proposed slip interpretation of such anomalies. The test system consisted of a two-dimensional flow channel, having a uniform width of 1.5 inches, and, alternatively, an adjustable convergent taper. Dilute aqueous solutions of the polymers carbopol, natrosol, and polyox were recirculated in steady laminar flow from a large reservoir. During the tests, velocities, pressures, and wall shear stresses were measured. Local velocities were obtained by the local injection of conductive tracer fluid, whose passage was sensed by sets of electrodes stationed along the flow. Wall shear stresses were measured on a small, freely displaceable, traction surface flush with the channel wall. Dissert. Abstr.

N70-22735 Rutgers Univ., New Brunswick, N.J.
PROBLEMS IN FLUID-PARTICLE MECHANICS: THE CONTINUUM MODEL AND SINGLE PARTICLE MOTION
Robert Stewart Marshall (Ph.D. Thesis) 1968 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-7567

The first part is concerned with the mathematical analysis of the equations which govern the motion of a fluid-particle system when the latter is considered as a mixture of two coexistent continua. The method of characteristics is employed to analyze the quasi-linear system of first order, nonlinear, differential equations. The characteristic surfaces are shown to be: the fluid element trajectories, the particle trajectories, and a hypersurface the character of which is determined by the magnitude of the local fluid Mach number and the explicit dependence on, or independence of, the independent variable: time. It is found that, there exist only four independent compatibility equations corresponding to the particle trajectories, although they constitute a five-fold characteristic surface. The second part is addressed to the analysis of the unsteady rectilinear motion of a spherical particle in an unbounded Newtonian fluid, in the limit of small Reynolds number. The problem is approached by means of the Navier - Stokes equations using the linearized approximations of Stokes and Oseen. The former approximation neglects the convective acceleration terms in the momentum equation completely, while the latter includes these terms in an average sense. Dissert. Abstr.

N70-22739 Polytechnic Inst. of Brooklyn, N.Y.
VISCOUS CORNER FLOWS
Bernard Grossman (Ph.D. Thesis) 1969 185 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-20338

A method of analyzing the laminar incompressible flow along a corner formed by the intersection of two thin airfoil shapes is presented. The methodology consists of using the method of matched asymptotic expansions and the necessary corner layer to boundary layer to potential flow matching to determine the governing corner layer equations and their proper asymptotic boundary conditions. The effects of small axial pressure gradients are accounted for as a perturbation to the intersecting flat plate corner layer analysis. The numerical solution of the governing corner layer equations with and without axial pressure gradient is developed using relaxation techniques. An extensive treatment of the asymptotic boundary conditions is presented with attention to algebraically decaying terms and the evaluation of the arbitrary constant in these conditions. A comprehensive study is performed on the effects of grid spacing, the extent of the asymptotic boundary conditions on the accuracy of the numerical calculations. Dissert. Abstr.

N70-22750 Colorado Univ., Boulder.
A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE FLOW PHENOMENA BETWEEN TWO CO-ROTATING

PARALLEL DISKS WITH SOURCE FLOW
Even Bakke (Ph.D. Thesis) 1969 256 p
Avail: Univ. Microfilms: HC $11.70/Microfilm $3.30 Order No. 69-19521

Flow and transition phenomena were studied in source flow between two parallel, stationary and co-rotating, disks. The pressure distribution in source flow between two stationary disks and two co-rotating disks is treated theoretically and the disk pump performance is analyzed. Detailed experimental measurements of mean velocities, turbulence intensities, and radial pressure distributions, are presented for source flow between two stationary and two co-rotating disks. Also, reverse transition in source flow between two stationary disks was studied. The influence of the centrifugal forces on separated flow regions was investigated and similarity parameters, developed with the aid of the turbulent momentum equations, were verified. A new flow parameter which predicts the development of the radial velocity profiles, when the flow is under the influence of centrifugal forces, was discovered.
Dissert. Abstr.

N70-22763 California Univ., Los Angeles.
THE INTERACTION AND MOTION OF RIGID SPHERES FALLING IN A VISCOUS FLUID AT LOW REYNOLDS NUMBERS
James Dean Klett (Ph.D. Thesis) 1968 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-7249

The problem of the hydrodynamic interaction and motion of rigid spheres falling without rotation in an otherwise unbounded viscous and incompressible fluid at low Reynolds numbers is investigated. For the most part the number of spheres is restricted to two, which fall with arbitrary orientation in a fluid governed by the Oseen equations. Approximate expressions for the forces, including the first order dependence on the Reynolds numbers based on the radii of the spheres, are obtained through the general approach of expansion of the flow field in a set of orthogonal functions. This is followed by the use of simplifying constraints among the coefficients defining the flow, and by subsequent truncation of the resulting series expansions. The equations of motion for two identical spheres falling along their line-of-centers are integrated numerically.
Dissert. Abstr.

N70-22777# Politecnico di Torino (Italy). Ist. di Macchine e Motori per Aeromobili.
BEHAVIOR OF DIAPHRAGM AND ORIFICES WITH COMPRESSIBLE FLUID FLOW IN NONSTATIONARY MODE [COMPORTAMENTO DI DIAFRAMMI ED ORIFIZI ATTRAVERSATI DA FLUIDO COMPRESSIBILE IN MOTO NON STAZIONARIO]
Andrea Dadone and Maurizio Pandolfi Dec. 1968 30 p refs In ITALIAN *Its* Publ. No. 106
Avail: CFSTI

A theoretical model suitable for determining the characteristic intensity of reflected and transmitted shock waves of a pierced diaphragm in a shock propagating fluid, initially stationary relative to the tube is discussed. The analysis is limited to the study of those waves generated by subsonic flow. The experimental results obtained in a series of diaphragms, showing the relation of the diameter of the throat to the diameter of the tube are presented, and the experimental results are compared to theoretical findings.
Transl. by F.O.S.

N70-22779# Politecnico di Torino (Italy). Ist. di Macchine e Motori per Aeromobili.
THE TRANSMISSION AND REFLECTION OF SHOCK WAVES INCIDENT TO ORIFICES IN TUBES WITH STEADY STATE FLOW [TRASMISSIONE E RIFLESSIONE DI ONDE D'URTO PREESISTENTE]
Andrea Dadone and Maurizio Pandolfi Dec. 1969 30 p refs In ITALIAN; ENGLISH summary *Its* Publ. No. 116
Avail: CFSTI

Reflected and transmitted pressure waves which are generated by the interaction which takes place when an incident pressure wave reaches an orifice placed inside a duct are studied with initial steady flow through the orifice. A theoretical approach is outlined to relate the strength of reflected and transmitted pressure waves with orifice geometry, initial steady flow conditions and incident pressure wave. Several experiments have been carried out with incident shock waves and different size orifices; theoretical and experimental results are compared and the agreement is quite good. Some anomalous phenomena, observed during such experiments, are also included.
Author

N70-22780# Politecnico di Torino (Italy). Ist. di Macchine and Motori per Aeromobili.
INTERACTION BETWEEN SHOCK WAVES AND ORIFICE PLATES IN TUBES [INTERAZIONE TRA ONDE D'URTO E SETTI FORATI INTUBATI]
Andreh Dadone and Maurizio Pandolfi Nov. 1969 31 p refs In ITALIAN; ENGLISH summary *Its* Publ. No. 115
Avail: CFSTI

A theoretical model is outlined for estimating the effects of reflected and transmitted shocks which appear when a shock wave moves down a duct and reaches an orifice plate located inside it. Experiments were carried out measuring pressures upstream and downstream of the orifice. The experimental results agree well with the theoretical ones. Some anomalous phenomena have been observed, probably due to unsteady boundary layer growth or time lag in the establishment of steady flow conditions through the orifice.
Author

N70-22885 City Univ. of New York.
TWO-DIMENSIONAL SOLIDIFICATION OF VISCOUS FLOW OVER A SEMI-INFINITE FLAT PLATE
Morris L. Miller (Ph.D. Thesis) 1969 389 p
Avail: Univ. Microfilms: HC $17.55/Microfilm $5.00 Order No. 69-7605

An analytic and numerical solution to a two dimensional freezing problem involving viscous flow of the liquid phase is presented. An incompressible Newtonian fluid is flowing steadily over a horizontal semi-infinite flat plate. The flow is laminar and the surface of the plate is maintained at temperature which is above the freezing temperature of the fluid. The problem is to determine the location of the interface as a function of position and time. The solution is based upon an instantaneous source method which transforms the moving free boundary problem to a stationary free boundary problem. The inverse transformation operation yields a non-linear integro-differential equation of the Volterra type in terms of the unknown interface location and velocity. The numerical solution employs finite difference techniques and serves to verify the assumptions made in obtaining the analytic solution.
Dissert. Abstr.

N70-22893# Politechnico di Torino (Italy). Ist. di Meccanica Applicata.
EXPERIMENTAL STUDY ON SUPERSONIC FLUID AMPLIFIERS [STUDIO SPERIMENTALE SU AMPLIFICATORI BISTABILI SUPERSONICI]
Federico G. Bavagnoli Cranfield, Engl. Brit. Hydromechanics Res. Assoc. [1969] 16 p refs Presented at the 3d Cranfield Fluidics Conf., Turin, 8 – 10 May 1968 *Its* Paper F-8 (Rept-543) Avail: CFSTI

Four supersonic bistable amplifiers were built. Each one has a different maximum operating pressure (i.e. 2;4;6;8 kg/sq cm). The switching is actuated by the opening of a control vent, the other being closed. Measurements of recovery pressure, switching pressure, and response time were carried out. Qualitative information was obtained by means of optical visualization. The pressure recovery ranges from 20% to 30% of the supply pressure. The response time increases with the supply pressure. More experimental work directed towards the refinement of the characteristics of the elements is in progress.
Author

N70-22899 City Univ. of New York.
AXISYMMETRIC FLUID FLOW IN TUBES WITH SURFACE SOLIDIFICATION
Jonas A. Bilenas (Ph.D. Thesis) 1969 178 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-7599

Analytical and numerical solutions to an internal flow, two-dimensional free boundary problem. The physical problem considered here relates to an axisymmetric fluid flow in tubes with surface solidification and belongs to a general class of nonlinear free boundary problems. The free boundary problems are characterized by the moving boundaries whose motion is not known a priori but must be determined as part of the solution. The analytical solution developed in this dissertation is based on the Lagrangian formalism of the variational principle. The method is extended to treat the internal flow free boundary problems with identical mass densities in the liquid and solid phases. The interface position, temperatures, velocities, heat fluxes, and pressures calculated by the analytical and numerical methods are compared. The analytical errors are generally of the order of 15%. Dissert. Abstr.

N70-22938# Sandia Corp., Albuquerque, N.Mex.
TOODY 2A: A COMPUTER PROGRAM FOR TWO DIMENSIONAL WAVE PROPAGATION CDC 6600 VERSION
S. E. Benzley, L. D. Bertholf, and G. E. Clark Nov. 1969 155 p
(PB-187807; SC-DR-69-516) Avail: CFSTI CSCL 18C

TOODY II-A is a FORTRAN code for computing the solution to wave propagation problems in two dimensions. It allows for up to six different equations of state subroutines. Subroutine STATE1 is a hydrodynamic-elastic-plastic material description with the added feature of vaporization. STATE2 is for the detonation of high explosives, treating the products as ideal gases. STATE4 and STATE5 are currently dummies and can be programmed as the user desires. The subroutine STATE6 included with this version of TOODY treats distended solid materials according to a model which is essentially hydrodyanmic, where the needed reference states are described by the Hugoniot of the non-distended material. USGRDR

N70-22967# Politechnico di Torino (Italy). Ist. di Meccanica Applicata.
TANGENTIAL STRESS VISUALIZATION BY MEANS OF BIREFRINGENT LIQUID [VISUALIZZAZIONE DI SFORZI TANGENZIALI CON LIQUIDI BIRIFRANGENTI]
Guido Belforte Cranfield, Engl. Brit. Hydromechanics Res. Assoc. [1969] 13 p refs Presented at the 3d Cranfield Fluidics Conf., Turin, 8-10 May 1968 *Its* Paper M-3
(Rept-541) Avail: CFSTI

Some visualization tests on a moving fluid, by means of birefringent liquid are presented. The use of light, plane and circularly polarized giving: isoclinics and isochromatics is described. The determination of the order of fringes, the circuit used and the optical apparatus is described. Tests performed on several fluidic elements are presented. Author

N70-22971# Michigan Univ., Ann Arbor. Dept. of Naval Architecture and Marine Engineering.
OSCILLATING PRESSURE FIELDS ON A FREE SURFACE Interim Technical Report, 1 Mar. -31 Jul. 1969
T. Francis Ogilvie Sep. 1969 61 p refs
(Contract N00014-67-A-0181-0016)
(AD-698846; Rept-030) Avail: CFSTI CSCL 13/10

The effect of a vertical barrier or lip on the wave generating capability of a pneumatic wavemaker is analyzed. For lip immersion approaching zero, the wave amplitudes approach the values predicted by Stoker in 1957. For finite lip immersion, wave amplitude is generally reduced below the amplitude from a wavemaker with no lip, but under certain conditions the amplitude can be greatly increased by the lip. Numerical results are presented. These results are used to show that the effect of sidewalls will be generally negligible in predicting the added mass and damping per unit length of a long air-cushion vehicle with sidewalls (captured-air-bubble vehicle). Such effects then being neglected, the added mass and damping are computed as functions of frequency and conditions of static support. The amplitude and phase of the mean free surface motion under the vehicle are also computed. It is found that the surface motion can actually be exactly opposite to that expected from quasi-static considerations. Author (TAB)

N70-23002 California Inst. of Tech., Pasadena.
AN ANALYSIS OF THE INCOMPRESSIBLE TWO DIMENSIONAL JET EJECTOR
James Robert Rose (Ph.D. Thesis) 1969 122 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-19600

A general method for calculating the performance of two-dimensional jet ejector systems is presented, with special emphasis on those qualities desired in thrust augmenter devices. The nature of the viscous-inviscid interaction problem is examined and a frictionless model is defined. The equations are solved for the particular parametric problem of a single jet in a finite length shroud of uniform height. The flow in the recovery of confined-mixing region is discussed for this model and techniques are developed which may be applied to devices with diffusing systems. The solutions presented for the free-mixing or interaction region are shown to agree with the simple channel flow studied analytically and experimentally by Curtet. Dissert. Abstr.

N70-23008# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
PROBLEMS OF INVESTIGATING ELEMENTS OF FLUIDICS IN WHICH THE PROPERTIES OF WALL FLOW ARE EMPLOYED [CERTAINS PROBLEMES POSES PAR L'ETUDE DES ELEMENTS A JETS D'AIR COMPRIME UTILISANT LES PROPRIETES DES ECOULEMENTS PARIETAUX]
I. A. Zalmanzon 1968 19 p refs Transl. into FRENCH from Romanian Rept. In FRENCH and RUSSIAN
(LRBA-69-0590) Avail: CFSTI

It is noted that in fluid jet components, the effect of which is based on the use of wall flow properties, the Coanda effect is encountered in conjunction with a number of other hydroaerodynamic effects. Problems arise for joint study of phenomena observed during flow of the working medium in components of a given type. Examples are given which illustrate the necessity of a complex approach to investigation of the hydroaerodynamics of such components, and problems of modeling their characteristics are considered. Transl. by R.B.

N70-23010# Cekmece Nuclear Research Center, Istanbul (Turkey).
FLUCTUATION ANALYSIS IN SIMPLE FLUIDS
A. Ziya Akcasu and E. Daniels (Michigan Univ., Ann Arbor) Nov. 1969 57 p refs
(CNAEM-67) Avail: CFSTI

A classified analysis of time-correlations in simple fluids, based on the generalized Langevin equation is presented. Formulas for the current-current correlations are developed explicitly in region of frequencies and wave numbers which are explored in typical slow neutron scattering measurements. Where applicable, comparisons are made with the results of the numberical calculations of of Rahman in argon-like liquids, and good agreement is generally found. The analysis is based on a hydrodynamic description of fluids involving frequency and wave-length dependent transport parameters. The frequency and wave-length dependence of shear and longitudinal viscosities are given explicitly for argon-like liquids. Author

N70-23011# Politecnico di Torino (Italy). Ist. di Meccanica Applicata.
ON THE BEHAVIOUR OF AIR DIODES [SUL COMPORTAMENTO DEL DIODO FLUIDICO AD ARIA]
Guido Belforte Cranfield, Engl. Brit. Hydromechanics Res. Assoc. [1969] 17 p refs Presented at the 3d Cranfield Fluidics Conf., Turin, 8-10 May 1968 *Its* Paper F-6
(Rept-542) Avail: CFSTI

In order to develop a fluidic diode, a wall effect element was studied. It realizes its function by deviating the cathode signal toward a dump. Two models were tested with air, and afterward, a comparison with the behavior with water was made. The design of diode is shown. In the forward flow operation, the flow travels from anode A to cathode C, and, in the reverse flow operation, the flow coming from the cathode is conveyed toward the dump V sub 2. In this case, the anode output flow is extremely reduced. Under certain conditions, suction may occur. With this type of diode, it is possible to get a zero reverse flow. Author

N70-23025# Politecnico di Torino (Italy). Istituto di Macchine e Motori per Aeromobili.

A SIMPLIFIED METHOD FOR EVALUATING THE PRESSURE WAVE REFLECTED FROM AN ORIFICE AT THE END OF A DUCT

Andrea Dadone Dec. 1969 19 p refs
(PUBL-117) Avail: CFSTI

A theoretical model for evaluating the pressure wave reflected from an orifice at the end of a duct is outlined. The readjustment of the mean exit pressure to its steady flow equilibrium level is assumed as being instantaneous. Regarding incident shock waves moving into a fluid at rest, theoretical predictions are compared with experimental results. A comparison is also reported with Rudinger's theoretical model, which takes into account time lags in the establishment of steady flow boundary conditions. Author

N70-23097 Lehigh Univ., Bethlehem, Pa.

STEADY-STATE PERFORMANCE OF FLUERIC DIODES

Frank Waters Paul (Ph.D. Thesis) 1968 222 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 69-7356

The performance of passive flueric diodes was investigated both experimentally and analytically. The studies involved the evaluation of fluid mechanic phenomena which affected the steady-state diode ratio. Boundary layers, jet interaction, separated flow, vortex flow, and unsteady flow were found to influence the performance of various types of diodes. Theoretical and experimental studies of several types of flueric diodes were conducted in order to evaluate the upper bound for one stage diode ratios. Results indicate that flueric diodes should be divided into two classes, vortex and non-vortex. Analytic estimates for composite diode ratios obtained by series or parallel staging indicate that the composite diode ratio could not be greater than the maximum diode ratio of an individual stage. A detailed analytic and experimental study was made on a momentum or Tesla flueric diode. Analytic models were postulated and substantiated using a large scale test diode. Dissert. Abstr.

N70-23158*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

POWER-LAW VELOCITY-PROFILE-EXPONENT VARIATIONS WITH REYNOLDS NUMBER, WALL COOLING, AND MACH NUMBER IN A TURBULENT BOUNDARY LAYER

Charles B. Johnson and Dennis M. Bushnell Washington Apr. 1970 57 p refs
(NASA-TN-D-5753; L-6757) Avail: CFSTI CSCL 20/4

A survey of turbulent-boundary-layer velocity profiles with zero or slightly favorable pressure gradients was made for Mach numbers up to about 20. The profiles were expressed in terms of the 1/N-power law for three basic classes of test configurations: (1) flat plates, cones, and hollow cylinders; (2) two-dimensional nozzle walls; and (3) axisymmetric nozzle walls. The values of N were plotted against Reynolds number based on momentum thickness for each of the three classes of configurations and for three groups of wall-to-total temperature ratios ranging from 0.12 to 1.35. It was found that there was generally an overshoot in the values of N for data obtained in the region of the beginning of turbulent flow. For profiles downstream of this region, the values of N correlated with Reynolds number based on momentum thickness. Author

N70-23180# United Aircraft Corp., East Hartford, Conn. Research Labs.

LABORATORY INVESTIGATIONS OF ATMOSPHERIC SHEAR FLOWS USING AN OPEN WATER CHANNEL

James W. Clark *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 18 p refs (See N70-23165 10-20)
Avail: CFSTI

A 2-ft-wide by 8-in.-deep by 10-ft-long open nonrecirculating water channel was used for investigations of stratified shear flows. This channel employs porous foam material at the inlet to shape the velocity profile and hot water nozzles to impose a temperature gradient; flexible side walls allow adjustment of the radius of curvature in the horizontal plane. Maximum flow velocity is about 1.0 ft/sec. Straight channel results correlate with the stability theories of Drazin and others in which unstable conditions are defined in terms of dimensionless wavenumber and Richardson number. Examples are given in which the results are used in analyses of clear air turbulence encounters associated with mountain lee waves. It is concluded that the results are useful in predicting turbulence within thin, initially stable shear layers which undergo destabilizing undulations such as occur in orographic and shear gravity waves. Author

N70-23227*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NUMERICAL SOLUTION OF UNSTEADY FLOW IN A RECTANGULAR CAVITY WITH A MOVING WALL

Leo F. Donovan [1969] 33 p refs
(NASA-TM-X-52767; E-5577) Avail: CFSTI CSCL 20/4

Unsteady flow in a two-dimensional, rectangular cavity with the upper wall moving at constant velocity is investigated. A numerical solution of the Navier – Stokes equations is used in which a Poisson's equation is solved iteratively for pressure and then velocities are calculated explicitly. The calculations start with the fluid at rest in the cavity and continue until no further changes in velocity occur. The aspect ratio of the cavity and the Reynolds number of the flow are the parameters of interest. Results for cavities with aspect ratios of 1/2, 1, and 2 are presented for a Reynolds number of 100. For a square cavity, results are also given for several Reynolds numbers between 100 and 500. The unsteady results are illustrated by showing velocity profiles and three-dimensional plots of the pressure field at several times during the development of the flow at for a Reynolds number of 500 in a square cavity. The paths of the instantaneous position of the vortex centers are also shown for all cases considered. Author

N70-23233# European Space Research Inst., Frascati (Italy).

THE BOW SHOCK AS A HIGH MACH NUMBER COLLISION-FREE SHOCK WAVE

K. Schindler and P. Goldberg *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 37–40 refs (See N70-23229 10-25)
Avail: CFSTI

The subsolar part of the earth's bow shock has an average Mach number of 6, but it is not a weak shock. This report discusses the following two features of high Mach number shocks: (a) that downstream states cannot necessarily be determined independently from the dissipation mechanism, and (b) the absence of laminar solutions. It is concluded that a Mach 8 bow shock is 'super critical' in that no laminar flow is possible when the wave is governed by dispersive effects. ESRO

N70-23261*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPUTER SOLUTION OF UNSTEADY NAVIER-STOKES EQUATIONS FOR AN INFINITE HYDRODYNAMIC STEP BEARING

Henry A. Putre Washington Apr. 1970 31 p refs
(NASA-TN-D-5682; E-5376) Avail: CFSTI CSCL 20D

The flow equations were programmed and solved for startup at a Reynolds number of 100 and for steady state at Reynolds

numbers of 300, 600, and 1000. Two different bearing geometries with a length-to-clearance ratio of 200 were studied. The startup solution indicates that 99 percent of the steady state lift is reached before the slider moves one-half of the bearing length. The steady state pressure profiles show a maximum step pressure drop of about 40 percent which is neglected in the usual Rayleigh analysis. This pressure drop results in a negligible lift reduction for an optimum bearing and a 2- to 14-percent lift reduction for an off-optimum bearing. Author

N70-23274# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

THE DYNAMIC STABILIZATION OF THE RAYLEIGH-TAYLOR INSTABILITY AND THE CORRESPONDING DYNAMIC EQUILIBRIUM

G. H. Wolf Jul. 1969 17 p refs

(IPP-1/96) Avail: CFSTI

Conditions are derived for dynamically stabilizing the Rayleigh-Taylor instability of a fluid interface and for attaining the corresponding dynamic equilibrium. These conditions were proved in experiments using an aqueous solution of potassium iodide as the heavy fluid and oil as the light one. Parametric resonances were suppressed, but could be observed using oil of a lower viscosity. Author (ESRO)

N70-23386*# Translation Consultants, Ltd., Arlington, Va.

DUST-INDUCED TURBULENCE OF THE WORKING FLOW IN A HYPERSONIC NOZZLE [PYLEVAYA TURBULIZATSIYA RABOCHEGO POTOKA V GIPERZVUKOVOM SOPLE]

B. I. Bakum Washington NASA Mar. 1970 7 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Tekhn. Nauk (Novosibirsk), no. 8, issue 2, 1969 p 32–35

(Contract NASw-2038)

(NASA-TT-F-12743) Avail: CFSTI CSCL 20/4

Investigation of turbulence arising in a hypersonic nozzle for the case of the two phase flow of an ideal gas and solid spherical particles with a mean size of 50 microns. Calculations show both thermal and dynamic differences between the particles in a major portion of the nozzle. As a result, the flow contains turbulent wakes trailing the particles and thus becomes turbulent. Author

N70-23370# Fraunhofer Institut, Freiburg (West Germany)

EXPERIMENTAL INVESTIGATION OF THE GENERATION OF SPHERICAL IMPLOSION WAVES [EXPERIMENTELLE UNTERSUCHUNGEN ZUR ERZEUGUNG SPHAERISCHER IMPLOSIONSWELLEN]

W. Struck Jul. 1969 19 p refs In GERMAN

(Rept-6-69) Avail: CFSTI

The dynamics of spherical implosion waves generated in a spherical chamber are discussed. The experimental arrangement to take schlieren and normal photographs is described and an interpretation of the results is attempted. ESRO

N70-23400*# Aerojet Liquid Rocket Co., Sacramento, Calif.

DEVELOPMENT OF STEADY-STATE AND DYNAMIC PERFORMANCE PREDICTION METHODS FOR TURBOPUMP SELF-COMPENSATING THRUST BALANCE SYSTEMS Final Report

W. E. Watters and L. Luehr 30 Mar. 1970 461 p refs

(Contract NAS3-7978)

(NASA-CR-72630; AGC-9400-19-Rev-1) Avail: CFSTI CSCL 20D

Steady state and dynamic performance prediction methods were developed for turbopump self-compensating thrust balance system. A test assembly was designed and fabricated. This assembly accommodated either a series flow (single-acting) or a parallel flow (double-acting) balance piston with provisions for varying slit lengths, pocket depths, orifices, mechanical spring rates, and friction damping. A 100 hp, single-stage impulse turbine with a maximum 10,000 rpm test capability was used as the drive unit. Digital and analog computer programs were formulated to predict steady state and dynamic performance. These programs then were used in parametric studies to ascertain the effect of selected changes in the test assembly. Testing was accomplished with both the parallel and series balance pistons using water as well as gaseous nitrogen as the test fluids. Orifice, slit entrance, and slit exit coefficients were obtained along with rotation factors. Computer predictions correlated very well with test results when the experimentally determined coefficients were used. Dynamic results also correlated well with water as the test fluid, but no confirmation for the gaseous nitrogen was obtained because of excitation damping in the supply system. Author

N70-23423*# Hydronautics, Inc., Laurel, Md.

THREE-DIMENSIONAL FLOW FIELD FROM A RADIAL VORTEX FILAMENT IN A CYLINDRICAL ANNULUS

R. J. Etter and P. Van Dyke Dec. 1969 63 p refs

(Contract NAS8-20625)

(NASA-CR-102560; TR-703-7) Avail: CFSTI CSCL 20D

A computer program to solve the three dimensional flow field was written. The convergence of the solutions depends on proximity to the vortex filament, with more and more terms required in the summation as the filament is approached in either the axial or tangential direction. Considerable disagreement was found between the present three dimensional results and results reported earlier except at the mid-radius. A systematic deviation was found between the present three dimensional calculations and the two dimensional approximation with maximum differences on the order of 25%. The larger the hub/diameter ratio, the closer the three dimensional results are to the two dimensional. Eigenvalues and coefficients required for the three dimensional calculations at the hub/diameter ratios of 0.60, 0.70, and 0.80 are tabulated, along with actual velocities for the 0.70 ratio. Author

N70-23426*# Michigan State Univ., East Lansing. Dept. of Mathematics.

ON A POINT LOAD APPLIED TO A MIXTURE OF INTERACTING CONTINUA

Charles J. Martin [1969] 47 p refs

(Grant NGR-23-004-041)

(NASA-CR-109323) Avail: CFSTI CSCL 20D

The response of an infinite body to a stationary impulsive body force when the body is composed of an interacting mixture of solid and fluid is studied. The linearized mixture theory for an isotropic elastic solid and Newtonian fluid is used. The problem is solved by means of Fourier and Laplace transforms. Fourier inversion is accomplished in two steps, and the Laplace transform is inverted to yield integral representations of the solution for the special case when the diffusive force parameter is zero. Special cases for inviscid fluids and for uncoupled field equations are discussed. Author

N70-23488*# CETEC Corp., Mountain View, Calif.

THEORETICAL AND EXPERIMENTAL STUDY OF SUPERSONIC MIXING OF TURBULENT DISSIMILAR STREAMS

James P. Woolley [1969] 118 p refs

(Contract NAS1-6076)

(NASA-CR-66893) Avail: CFSTI CSCL 20D

A theoretical and experimental program was conducted to investigate the effects of molecular weight and other gas properties on the rate of mixing of dissimilar supersonic gas streams. An analysis of the supersonic mixing process was made by extending the original analysis. A reference density criteria was developed which permits prediction of isobaric turbulent mixing rates in the near field for compressible flow of similar gases. This unique reference density approach was confirmed experimentally for isoenergetic streams. The prediction method was also extended analytically to compressible flows with streamwise pressure gradients. The effects of molecular weight on the mixing process

were also described analytically. Experimental mixing data with air streams are reported for several velocity ratios and for conditions of an adverse pressure gradient. Author

N70-23494# Cambridge Univ. (England). Dept. of Engineering.
CROSSFLOW IN TURBULENT BOUNDARY LAYERS
N. A. Cumpsty Aeron. Res. Council 1970 17 p refs Supersedes ARC-30782
(ARC-CP-1067; ARC-30782) Copyright. Avail: CFSTI

Two well-known representations for the crossflow velocity profile, are discussed, and limitations to their applicability are outlined. A number of ideas relating to the Johnston triangular model are discussed, and a method for extending its usefulness is presented. Finally an approach which should lead to a prediction of the form of cross-over crossflow profiles is described. The predictions are shown to be consistent with the available measured profiles. Author (ESRO)

N70-23495# Cambridge Univ. (England). Dept. of Engineering.
A CRITICAL EXAMINATION OF THE USE OF A TWO-DIMENSIONAL TURBULENT PROFILE FAMILY TO REPRESENT THREE-DIMENSIONAL BOUNDARY LAYERS
N. A. Cumpsty Aeron. Res. Council 1970 37 p refs Supersedes ARC-30781
(ARC-CP-1068; ARC-30781) Copyright. Avail: CFSTI

The streamwise velocity profile is established as the most suitable basic profile for the calculation of three-dimensional turbulent boundary layers. Measured streamwise profiles are compared with Thompson's two-dimensional profile family, and it is shown that the discrepancies produced by the variation of flow direction within the boundary layer, the pressure gardient normal to the external flow, and the convergence or divergence of the flow are generally small. The result of the streamwise pressure gradient can be very appreciable. The four effects listed above are expressed as nondimensional parameters and limits are suggested within which the streamwise profile is likely to be moderately well represented by Thompson two-dimensional profiles. Some consideration is given to the associated problem of estimating the coefficient of skin friction in three-dimensional boundary layers, and some alternative methods are compared. Author (ESRO)

N70-23500# Purdue Univ., Lafayette, Ind. Project SQUID Headquarters.
THEORETICAL DETERMINATION OF THE DISCHARGE COEFFICIENTS OF AXISYMMETRIC NOZZLES UNDER CRITICAL FLOWS
S. P. Tang (Princeton Univ.) Oct. 1969 43 p refs
(Contract 000014-67-A-0226-0005)
(AD-698285; SQUID-TR-PR-118-PU) Avail: CFSTI CSCL 20/4

Discharge coefficients of axisymmetric contoured nozzles under steady, critical flow conditions were studied theoretically. In the analysis, axisymmetrical compressible laminar boundary layer flow was considered for a perfect gas with Prandtl number unity and viscosity proportional to temperature. The wall was assumed to be adiabatic. Solutions to the equations describing the discharge coefficient were obtained analytically in closed form when the pressure-gradient parameter Beta was infinite. Numerical computations were carried out for two other cases, beta = 2 and beta = 1. TAB

N70-23667# Aerodynamische Versuchsanstalt, Gottingen (West Germany). Max-Plank-Institut fur Stromungforschung, Gottingen (West Germany).
STABILITY OF SPIRAL FLOW IN A CYLINDRICAL TORUS [STABILITAET SPIRALIGER STROEMUNGEN IN EINEM ZYLINDRISCHEN RINGRAUM]
E. Wedemeyer 1969 84 p refs In GERMAN Prepared jointly with Max-Planck-Inst. fur Stroemungsforsch.
(MITT-44-1969) Avail: CFSTI

The Ludwieg stability theory for spiral flow in a narrow cylindrical torus was extended to the case of flow in a broad torus and flows for which the curvature of the velocity profiles is essential. A stability condition was derived which makes it possible to decide, on a numerical basis, whether a given spiral flow was stable or not. With the aid of the stability condition, the stability boundaries for spiral flow with a turning-point profile were calculated. ESRO

N70-23706# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
BLUNT BODY SUPERSONIC FLOW: INVESTIGATIONS ABOUT AN INVERSE AND A DIRECT METHOD
C. R. Traas 4 Oct. 1967 85 p refs
(NLR-TN-G-63) Avail: CFSTI

An accurate inverse method for the numerical computation of the supersonic flow around a blunt body, with ideal gas properties, is presented. By a suitable transformation, the field is mapped on a rectangular strip. Integration of the equations of motion in the transformed domain is performed by simultaneous application of a third order predictor-corrector process in the subsonic part. Numerical instabilities encountered are discussed, and a smoothing technique for suppressing them is indicated. The results obtained are compared with results from literature. The merits of the one-strip direct approach are investigated. Computational results are compared with those obtained by other methods, in particular with respect to accuracy and computer time. Author (ESRO)

N70-23742# Southampton Univ. (England). Dept. of Mathematics.
THE STABILITY OF BOUNDARY CONDITIONS IN THE NUMERICAL SOLUTION OF THE TIME-DEPENDENT NAVIER-STOKES EQUATIONS
P. J. Taylor London HMSO 1970 47 p refs Supersedes ARC-30406; N69-18704
(ARC-CP-1066; ARC-30406) Copyright. Avail: CFSTI

This paper investigates the stability of finite-difference schemes, including boundary conditions, for solving the time dependent Navier–Stokes equations. The different types of boundary condition which may occur are listed and no-slip conditions are derived for a wall with suction. Stability analyses are completed for one dimensional problems with various types of boundary conditions, using schemes suitable for two dimensional problems. All the conditions introduced are shown to be stable if there is no flow across the boundary. For suction at a fixed or moving wall, it is shown that the mesh size must be restricted for both accuracy and stability. Author (ESRO)

N70-23792# Colorado Univ., Boulder.
THE LINEAR THEORY OF THERMAL CONVECTION IN HORIZONTAL PLANE COUETTE FLOW
Robert P. Davies-Jones Aug. 1969 231 p refs
(Contract F19628-67-C-0304)
(AD-698350; AFCRL-69-0382; SR-5) Avail: CFSTI CSCL 20/4

An examination is made of the effects of horizontal shear on thermal convection with a simple model in which an incompressible fluid is contained in an infinite channel. The initial steady state assumed is one of constant horizontal shear in the mean flow and constant (unstable) temperature gradient. Small disturbances are then introduced and the linearized perturbation equations solved. In the inviscid, non-conducting case it was found that for the largest scale modes the pressure forces cause the momentum transport to be up the gradient at short wave-lengths but at long wave-lengths (except for the lowest mode) inertia effects dominate the flow, giving down-gradient transport. It was also found that with rotation about a vertical axis the Reynolds stress is non-zero even in the absence of shear. Thus, a mean flow should develop even if there were none initially. In the general case with shear and rotation it was found that for convective cells whose wave-lengths along the channel are comparable with the channel width, the disturbances with growth rates small compared to the angular rotation rate transport momentum up the gradient. It is suggested that the interaction of giant, long-lived convection cells with the solar rotation

might give an equatorward momentum transport that would support a differential rotation. In the real fluid case (without rotation) it was found that the preferred modes of convection are cells which resemble transverse rolls in the absence of shear, and longitudinally elongated cells when shear is present. Author (TAB)

N70-23868# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Aachen (West Germany). Inst. fuer Theoretische Gasdynamik.

POSSIBILITIES AND LIMITATIONS OF LINEARIZATION IN FLUID MECHANICS [MOEGLICHKEITEN UND GRENZEN DER LINEARISIERUNG IN DER STROEMUNGSMECHANIK]

1969 26 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22–24 Sep. 1969 Prepared jointly with Wien Univ.

Avail: CFSTI

After a review of several theories on linearization in fluid mechanics, it is shown that the right type of linearization can often save time, e.g. in calculations on nose profiles by using streamline coordinates and in entropy layer or turbulence calculations by using particle coordinates. Wave coordinates should be used for propagation, when accuracy is necessary at large distances from the disturbing center as with hypersonic booms. Linearity or non-linearity is a problem in the mathematical treatment of the dependent and independent variables. ESRO

N70-23904*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INTERFACE STABILITY DURING LIQUID INFLOW TO INITIALLY EMPTY HEMISPHERICAL ENDED CYLINDERS IN WEIGHTLESSNESS

Eugene P. Symons Washington Apr. 1970 21 p refs
(NASA-TM-X-2003; E-5498) Avail: CFSTI CSCL 20D

An experimental investigation was conducted in a weightless environment to study the behavior of the liquid-vapor interface during liquid inflow to hemispherical ended cylinders which were initially void of liquid. During inflow, both stable and unstable behavior of the liquid-vapor interface was noted. The stability of the liquid-vapor interface has previously been correlated by a Weber number based on inlet line radius and average inflow velocity. This report extends the correlation to larger tanks and inlet line radii by the use of the 5- to 10-second zero gravity facility. As was previously determined, the value of the critical Weber number was again found to be 1.3. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N70-22546# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

SEISMIC WAVE VELOCITY AS A MEANS OF IN-PLACE DENSITY MEASUREMENT, PART 2 Final Report

J. M. Hoover and R. L. Handy 25 Jun. 1969 61 p refs
(PB-187798; ERI-479) Avail: CFSTI CSCL 13B

The report, containing 36 figures and seven tables, describes the results of both laboratory and field testing. Field laboratory tests and in-place field tests were made over 18 compacted soil types, some of which were primed, and four asphalt base materials located in 18 counties well scattered throughout the State and involving 189 seismic tests and 113 in-place density measurements. Both field laboratory test data and the in-place field test data were plotted in graphs with moisture content as abscissa and seismic velocity and/or maximum dry density as ordinates. USGRDR

N70-22597*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE EFFECT OF CYCLONIC AND ANTICYCLONIC WATER MOVEMENTS ON THE DISTRIBUTION OF ORGANIC MATTER

K.-H. Szekielda (NAS-NRC) Feb. 1970 17 p refs
(NASA-TM-X-63849; X-622-70-40) Avail: CFSTI CSCL 08A

An anticyclonic water movement directed away from the upwelling region along the Somali Coast was detected with the high resolution infrared radiometer aboard the meteorological satellite Nimbus 2. The effect of this water movement on the distribution of organic matter is shown with a stoichiometrical model, based on elementary analyses of phytoplankton. The predicted position of the maximum of the organic material was verified with chlorophyll measurements near the Somali Coast. Author

N70-22637# Woods Hole Oceanographic Institute, Mass.

GRAVITY DATA OBTAINED DURING CHAIN CRUISE 75 Technical Report

Carl Bowin, Thomas C. Aldrich, and Alice Wertheimer Mar. 1969 168 p refs
(Contract NONR-4029(00); Grant NSF GA-1298)
(AD-698791; WHOI-REF-69-16) Avail: CFSTI CSCL 8/10

Profiles, tabulations, and charts are presented of principal gravity facts, free-air gravity anomalies, and simple Bouguer gravity anomalies obtained in the North Atlantic Ocean and Caribbean Sea during R/V CHAIN Cruise 75. Author (TAB)

N70-22741 Rutgers Univ., New Brunswick, N.J.

RELICT PLAGIOCLASE PHENOCRYSTS FROM METAVOLCANIC ROCKS MANTLING A GRANITE DOME AND THE PETROLOGY OF THE ASSOCIATED ROCKS IN THE GRENVILLE PROVINCE OF SOUTHEASTERN ONTARIO

William Henry Spence (Ph.D. Thesis) 1968 84 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-7587

A granite dome mantled by metavolcanic rocks, metaconglomerate and other metasedimentary rocks occurs near Plevna Lake in the Madoc-Bancroft area of southeastern Ontario. The Madoc-Bancroft region contains the only low grade metamorphic rocks and unequivocal metavolcanic rocks of the Grenville Province. A major emphasis of this study is the effects of metamorphism on relict calcium-rich plagioclase phenocrysts in the metavolcanic rocks and the petrology of the associated rocks. Apparently anomalous field relationships between metaconglomerate with granitic clasts and the underlying granite are clarified by evidence that (1) while the clasts closely resemble the granite megascopically, modal analyses show that most of them are unrelated plutonic rocks and (2) there is a border zone of the granite that is mineralogically and texturally distinct which is a chilled zone. The metavolcanic sequence includes both pyroclastic rocks and porphyritic andesite-basalt flows; many are so completely recrystallized that the original rock type is unrecognizable. Dissert. Abstr.

N70-22754 California Univ., Los Angeles.

THE RADIATION PATTERN OF THE LONG-PERIOD P-WAVE PULSE: A MEASURE OF STRAIN AT THE FOCUS OF DEEP EARTHQUAKES

Michael John Randall (Ph.D. Thesis) 1968 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-8105

The simple pulse observed on the long-period WWSSN instruments shows that the pulse amplitude is a useful measure of the strain release at the source of deep earthquakes. With the aim of providing a criterion to discriminate between a shear mechanism and the possibility of sudden phase transition as a mechanism of deep earthquakes, these amplitudes were used to fit the radiation pattern on the focal sphere to a sum of zero-degree and second-degree surface harmonics. The six coefficients of the expansion are related to the components of strain release tensor at the source. While the coefficients of the zero degree, which is

a measure of permanent change of volume at the source, is apparently significantly different from zero in most of the cases studied. Thus some process involving shear instability is needed to explain the mechanism of deep earthquakes. The relative amplitudes of P and S waves appear to favor a source which involves shear spread throughout a volume rather than one which involves dislocation. Dissert. Abstr.

N70-22764 Alaska Univ., College.
THE TWILIGHT ENHANCEMENT OF THE AURORAL AND NEBULAR LINES OF NEUTRAL ATOMIC OXYGEN
Charles Sterling Deehr (Ph.D. Thesis) 1968 150 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-8021

A study of the auroral (5577 A) and nebular (6300 A) emissions of (OI) in the twilight airglow was carried out. An analysis of morning twilight observations, taken with a birefringent filter photometer, showed the twilight enhancement of both emissions to be due to photodissociation of O2. Analytical expressions were developed which described the intensities to be expected from this mechanism in the twilight, and then the physical parameters used in these expressions were varied to match the intensities observed under changing atmospheric conditions. Because only one production mechanism was important, it was possible to draw conclusions about the physical processes involved and about the state of the atmosphere at the time of the observation. Observations during undisturbed, magnetically quiet winter twilights indicated an atmosphere which is best described by the 1965 COSPAR Reference Atmosphere with an exospheric temperature of approximately 750 K. Dissert. Abstr.

N70-22823# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Jul. 1969 [OBSERVATIONS GEOPHYSIQUES]
1969 43 p In FRENCH and DUTCH
Avail: CFSTI

Data are given from Dourbes geophysical observatory in Belgium relating to geomagnetism air radioactivity, ionospheric parameters, seismology, atmospheric electricity and cosmic rays for July 1969. ESRO

N70-22824# Danish Space Research Inst., Lyngby.
THE EFFECT OF LARGE SCALE IRREGULARITIES ON THE PROPAGATION OF VLF WAVES THROUGH THE LOWER IONOSPHERE WITH SPECIAL REFERENCE TO AURORAL HISS
Eigil Ungstrup Oct. 1969 21 p refs Sponsored by Tech. Univ. of Den.
Avail: CFSTI

The propagation of whistler waves through the D and E region of the ionosphere from above is considered and the influence of large irregularities simulating auroral arcs is studied. It is found that such irregularities greatly facilitate the transmission of whistler waves through the lower ionosphere. The problem is treated by means of ray tracing. Author (ESRO)

N70-22950*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MARSHALL SPACE FLIGHT CENTER GRAVITY NETWORK
William M. Greene 15 Apr. 1969 75 p
(NASA-TM-X-53833) Avail: CFSTI CSCL 08K

Initial field seismic measurements at proposed measurement sites for the laser absolute gravimeter (LAG) were made at seven locations in and around Redstone Arsenal, Huntsville, Alabama. To meet the LAG test requirements, a local and statewide gravity net was established. All data conclusively indicated the necessity for seismic isolation. This was achieved through utilization of numbers of techniques and the acquisition of an optimum, permanent field site. Author

N70-22953# Saclant ASW Research Center, La Spezia (Italy).
ON THE CORRELATION FUNCTIONS IN TIME AND SPACE OF WIND-GENERATED OCEAN WAVES
Jan Geert de Boer 15 Dec. 1969 46 p refs
(Saclantcen-TR-160) Avail: CFSTI

When wind-generated ocean surface waves are described statistically by means of a wave energy spectrum, the correlation function for the surface elevation at two points and two instants of time follows as an integral over the wave spectrum. The time-correlation function and the spatial correlation function, which are important for the statistical description of an underwater sound field scattered from the sea surface, follow from this integral as special cases. They are examined here for two proposed spectra, the Neumann and the Pierson – Moskowitz spectra, by numerical integration. It is shown that the spatial correlation function, although a function of two variables, can be expressed in terms of two functions of only one variable each, when a cosine-squared law for the directionality of the wave spectrum is assumed. These functions are tabulated and plotted. A very simple relation is sufficient to reconstruct the entire anisotropic spatial correlation function from these basic functions. Author (ESRO)

N70-22998 Alaska Univ., College.
THE INFLUENCE OF COASTAL AND SEA FLOOR GEOMETRY ON NATURAL ELECTROMAGNETIC VARIATIONS OF .0001 TO 1000 Hz
J. Roger Blake (Ph.D. Thesis) 1968 440 p
Avail: Univ. Microfilms: HC $19.80/Microfilm $3.00 Order No. 69-8019

The influence of a sloping sea floor on the electric and magnetic fields at the ocean surface is calculated for various basement conductivities. The calculations refer to sites remote from a coastline and are applied to observations on ice-islands in the Arctic Ocean. The vertical magnetic field is enhanced over the shallower depths, while the electric field polarization shows a transition from the behavior on the landward side of a continental shore to that on the seaward side. The width of the transition region is approximately ten times the oceanic penetration depth. The fields are computed for slopes of 3 and 10 deg and compared with those over an ocean with horizontal floor. Dissert. Abstr.

N70-23004# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
PRELIMINARY INVESTIGATION BY CRN OF SOME LITHOLOGICAL TYPES IN THE TRISAIA REGARDING THE POSSIBILITY OF CONTAMINATION OF THE GROUND WATER AND SURFACE WATER [INDAGINE PRELIMINARE SU ALCUNI TIPI LITOLOGICI DEL CRN DELLA TRISAIA IN RELAZIONE ALLA POSSIBILITA DI CONTAMINAZIONE DELLE FALDE ACQUIFERE E DELLE ACQUE DI SUPERFICIE]
G. Cassano, G. Lenzi, and A. Marzocchi 1969 22 p refs In ITALIAN
(RT/PROT(69)22) Avail: CFSTI

The general geological situation of the C.R.N. Trisaia (CNEN) and of its neighbouring places is described; particularly the stratigraphy of a well placed in the Centre designed to receive medium and high level solid radioactive wastes is studied. The rocks of the geological survey and of the well, the technics for preliminary research about sorption ability of some fission products by some selected samples are described. The samples are as follows: bottom silt (of Sinni River), clay, sand, pudding stone. The sieve grading analysis of the above samples are reported and some security hypothesis about the sorption ability of the studied rocks are made. Author

N70-23113# Defence Research Board, Ottawa (Ontario).
A HISTORICAL OUTLINE OF FORECASTING METHODS
J. H. Meek *In* AGARD Ionospheric Forecasting Jan. 1970 9 p refs (See N70-23112 10-07)
Avail: CFSTI

A historical outline of ionospheric disturbance will be presented. Application to radio communication circuits were started during World War II and have evolved since then towards qualitative and, later, quantitative estimates of ionospheric radio propagation conditions hours and days in advance. Author

N70-23115# Environmental Science Services Administration, Boulder, Colo.

US ACTIVITIES IN OPERATIONAL SOLAR GEOPHYSICAL FORECASTING

R. D. Doeker and D. S. Packwett (Weather Wing (4th), Ent AFB, Colo.) *In* AGARD Ionospheric Forecasting Jan. 1970 10 p Prepared jointly with the AF (See N70-23112 10-07)

Avail: CFSTI

The Solar Forecast Facility's Solar Observing and Forecasting Network (SOFNET) is described and the solar forecast center at Colorado Springs, Colorado is discussed. The Solar Forecast Center collects and analyses solar and geophysical data received from the SOFNET. From these analyses, routine forecasts are issued for: (1) major flare occurrences; (2) solar radio flux at 10 cm; and (3) planetary geomagnetic indices. Solar Activity Forecast techniques and recent forecast verification data are presented. Currently planned automation of the Solar Forecast Center is discussed. Author

N70-23117# Centre National de la Recherche Scientifique, Meudon (France).

THE SHORT TERM FORECAST OF SOLAR ACTIVITY AND GEOPHYSICAL EVENTS

P. Simon *In* AGARD Ionospheric Forecasting Jan. 1970 12 p refs (See N70-23112 10-07)

Avail: CFSTI

Radioastronomy has given the first possibility of an easy identification of the solar events linked with the most outstanding geophysical events. Then the originating active centers have been carefully studied and now they are identified on the solar disk before the event occurrence. A new improvement is due to the solar magnetographs: the place and the birth of a flare are strongly linked to the structure and to the evolution of these solar magnetic fields. The detection of a flux of low energy solar particles opens the opportunity to specify the propagation situation into the deep interplanetary space. Using all this complementary material, a forecasting center working on a routine basis has predicted solar activity with a surprising accuracy (between 80 and 90 %) and has announced in advance a considerable number of the most outstanding events (between 50 and 70 %). Author

N70-23118# Naval Research Lab., Washington, D.C. Hulburt (E. O.) Center for Space Research.

PREDICTIONS OF SOLAR FLARE ACTIVITY BASED ON SOLAR X-RAY ENERGY FLUX MEASUREMENTS

D. M. Horan and R. W. Kreplin *In* AGARD Ionospheric Forecasting Jan. 1970 13 p refs (See N70-23112 10-07)

Avail: CFSTI

X-ray and particle emission during solar flares can sufficiently increase the electron density in the lower ionosphere to cause disruption of high frequency radio communications. For several years the Naval Research Laboratory has been using satellite-borne detectors to measure solar X-ray energy flux in the 0.5-3A, 1-8A, 8-20A, 1-20A, and 44-60A bands. The daily data sample covers from thirty to ninety minutes over a twenty-four hour span. Based on these measurements, statistical criteria have been established to predict periods of high solar activity during which solar flares capable of disrupting communications might occur. A study of the occurrence of Class 2 or greater flares over a twenty-three month period shows that these large flares are four times more likely to occur when the criteria are met than when they are not met. This result is quite promising considering the sparse X-ray data with which the criteria were formulated. Author

N70-23121# Air Force Weapons Lab., Kirtland AFB, N. Mex.

PROTON EVENTS IN 1967 - 1968

George A. Kuck *In* AGARD Ionospheric Forecasting Jan. 1970 14 p refs (See N70-23112 10-07)

Avail: CFSTI

Radio and X-ray data give an important indication of proton production. Cm radio bursts with a high flux density and a slope reflecting greater flux values at higher frequencies are often proton productive. Examination of data summaries have shown that the meter classification of flares as type II or type IV, even though qualitative, should be used in conjunction with the cm radio criteria. The peak intensity of the proton flux $E \geq 25$ meV correlates better with the integrated .5-5 A X-ray bursts than with the integrated cm radio bursts, peak cm radio flux, or peak X-ray flux. The proton events were examined in terms of both isotropic and anistropic diffusion theories. The anistropic diffusion theory can be used to extrapolate proton fluxes for $E \geq 10$ meV during 50% of the events. The isotropic diffusion theory can also be used. The isotropic diffusion theory uses a diffusion coefficient. If there is a direct connection between the polar geomagnetic field and the interplanetary magnetic field, and if there are no accelerating electric fields, the unidirectional interplanetary proton flux is directly related to the proton flux over the polar caps. A measurement of the interplanetary flux in near earth space gives a good indication of the polar cap fluxes. It was found that the 30 MHz absorption over the poles during a PCA is proportional to the square root of the integral proton flux $E > 11$ meV in interplanetary space. Author

N70-23124# McDonnell-Douglas Co., Santa Monica, Calif. Space Sciences Dept.

AN EVALUATION OF SOME OF THE NEW METHODS OF PREDICTING GEOMAGNETIC DISTURBANCE

Kenneth Moe *In* AGARD Ionospheric Forecasting Jan. 1970 10 p refs (See N70-23112 10-07)

Avail: CFSTI

Attempts to develop methods of predicting geomagnetic disturbance have usually involved correlation studies employing some of the phenomena which are associated with solar flares and geomagnetic storms. It has been known for decades that some geomagnetic storms occur several days after large solar flares, but that in other cases storms will recur for several solar rotations without the recurrence of major flares. The unequivocal separation of flare-associated storms from recurring storms first became possible with the launching of the Mariner Space Probes. In this paper, the predictive value of several newly available tools is evaluated: Naugebauer and Snyder's study of the solar wind speed, Castelli et al.'s study of PCA spectra, Anderson and Lin's study of energetic electrons, Fairfield's study of the interplanetary field direction, and Balliff et al.'s study of the perpendicular fluctuations of the interplanetary field. The measurements described in the above studies are introduced in the present investigation into a mathematical formulation to predict the contributions to geomagnetic disturbance of persistent streams and flare-associated streams of solar plasma. Author

N70-23131# Radio and Space Research Station, Slough (England).

THE USE OF SATELLITE DATA FOR PREDICTION PURPOSES

W. R. Piggott *In* AGARD Ionospheric Forecasting Jan. 1970 18 p refs (See N70-23112 10-07)

Avail: CFSTI

Analyses of satellite data for prediction purposes are discussed. Data from the circular orbit satellites, Alouette I and Ariel III are used, the former primarily for delineating rapid changes in foF2 with position, the latter primarily to explore the probable characteristics of the ionosphere in regions where ground based observations are not available. The data disclose some new ionospheric phenomena and can be used to give rules for extrapolating into zones where little or no data are available. Surprisingly large differences are found between the N and S hemisphere at corresponding seasons. An analysis has been made of ridges of ionisation and it is shown that the tilts associated with these can enable oblique incidence reflections to follow the ridges as they move about. Equivalent

ridges can be computed at the most probable position and used for HF predictions. This makes large differences in the predictions for certain times and zones. The data can also be used to estimate the probable importance of new observing sites. Author

N70-23138# Bureau of Meteorology, Sydney (Australia). Ionospheric Prediction Service Div.

ON THE TIME DELAY BETWEEN SOLAR FLARES AND ASSOCIATED GEOMAGNETIC STORMS

F. E. Cook *In* AGARD Ionospheric Forecasting Jan. 1970 12 p refs (See N70-23112 10-07)

Avail: CFSTI

Preliminary examination of data on solar flares, active regions, and associated geomagnetic storms during the period July, 1957 to December, 1959 suggests a relationship between the areas of the corresponding calcium plages and the flare-storm delay times, the delay being greater for flares occurring in smaller plage regions. The relationship breaks down with plages of area greater than about 90 × 0.0001 solar hemisphere, but smaller flare-associated regions may be identified within large plages in some cases. Author

N70-23139# Max-Planck-Institut fur Aeronomie, Lindau Uber Northeim (West Germany).

THE RELIABILITY OF TRANSPOLAR VLF MEASUREMENTS AS A METHOD TO FORECAST HF-PROPAGATION DISTURBANCES

G. Lange-Hesse and K. Rinnert *In* AGARD Ionospheric Forecasting Jan. 1970 14 p refs (See N70-23112 10-07)

Avail: CFSTI

A method is described of using real-time riometer data for short-term prediction on the course of absorption during PCA events. From Thule and other riometer stations, data on past PCA events have been analyzed for prediction. As the absorption rises above a threshold (0.7 dB at 30 MHz) at a station, when an event begins, the incoming data points are projected ahead by prediction routines at the forecasting central. Integrated flux-intensity data on the solar radio burst at centimetric wavelengths provide a useful estimate of the peak absorption for an event. For the period from this peak to noon the next day - during which absorption may decrease sharply during night hours and then rise to a second peak at noon, or it may decrease gradually if night hours do not occur at the station - the prediction is the least accurate. After this period, reasonable accuracy has been obtained. The predicted absorption values for the reporting riometer stations are fitted to models which prescribe the distribution of absorption in the polar region, for vertical incidence and 30 MHz. For conversion to lower frequencies of interest, models of frequency dependence for the absorption are based on theoretical calculations made for various electron-density and atmospheric-pressure profiles in the D-region. Author

N70-23140# Avco Corp., Lowell, Mass. Applied Technology Div.

PREDICTION OF DAILY FLUCTUATION OF THE F-REGION PLASMA FREQUENCY

S. M. Bennett and A. B. Friedland *In* AGARD Ionospheric Forecasting Jan. 1970 7 p ref (See N70-23112 10-07)

Avail: CFSTI

Seasonal and daily perturbations of the F-region plasma frequency occur without clear dependence upon solar-geophysical indices. Apart from the magnetic storm effect, the perturbations appear to be random in nature. It is attempted to relate daily fluctuations to daily solar flux changes and the 3-hour global magnetic index by statistical techniques. Multiple regression analysis of data obtained by 19 Northern Hemisphere vertical-incidence sounding stations during 1961 was performed. Hourly values of foF2, normalized to the station mean monthly value at each hour, solar flux at Ottawa normalized to the monthly mean value, and global magnetic index with a six hour lag, yielded statistically significant results for many periods studied. The most satisfactory intervals included a winter daytime relationship to the solar flux, and a summer daytime relationship with the magnetic index. The nighttime results were generally less satisfactory, probably due to magnetic storm effects. Of particular significance to forecasting is a large monthly perturbation related to 27 day periodicities in the 10-cm solar flux. Several other methods of forecasting foF2 on daily basis are compared. Author

N70-23141# Ionospharen-Institut Breisach (West Germany).

PRECURSOR EVENTS FOR POSSIBLE FORECASTING OF SPORADIC E AND INCREASED ABSORPTION

E. Harnischmacher and K. Rawer *In* AGARD Ionospheric Forecasting Jan. 1970 14 p refs (See N70-23112 10-07)

Avail: CFSTI

Simultaneous records of the characteristic frequencies of sporadic E at three stations have been digitalized with 24 readings per hour. The distances between stations were of the order of 300 km. A straightforward cross-correlation analysis centered on noon gave a widespread spectrum covering the whole range almost from −1 to +1 for the correlation number with important day-by-day changes. Therefore the monthly median correlation is almost zero. After filtering out the more persistent events, those were selected which appeared at the three stations, and the apparent motion of the ionized "clouds" was determined. The "motion vectors" agree well with the monthly E-region drift statistics obtained independently by local observations. The conclusion is that sporadic E clouds seem to drift with the general circulation in the height range where they appear. In winter the same records show series of subsequent days where E appears day-by-day at the same local hour plus one hour per day. Author

N70-23142# Avco Corp., Lowell, Mass. Space Systems Div.

F-LAYER PROPAGATION CHANGES DURING MAGNETIC STORMS

A. H. Katz *In* AGARD Ionospheric Forecasting Jan. 1970 10 p refs (See N70-23112 10-07)

(Contract F30602-67-C-0274)

Avail: CFSTI

Electron density profile changes during magnetic storms were studied and by ray tracing through the disturbed and undisturbed ionosphere, the effects of ionospheric changes associated with magnetic storms are determined. Ray tracing was performed for both a 1 and 2 hop F propagation path using magnetically quiet and disturbed electron density profiles obtained from four locations along the 75°W meridian. The electron density profiles were obtained from a true height analysis using hourly ionograms for selected time periods. An example of the changes that occur is illustrated by the effect of a sudden magnetic storm beginning at 1602 EST on 9 February 1963. Several hours later the height of the F-layer at Washington increased by 75−100 km and foF2 increased by 50% as compared to the previous magnetically quiet day. The effect of these two changes was to increase the MUF by 1−2 MHz; whereas, if it was assumed that just the critical frequency changed the MUF would increase by 3−4 MHz (depending on ground range). Author

N70-23151# Fernmeldetechnisches Zentralamt, Darmstadt (West Germany).

THE FORECASTING SYSTEM OF THE FERNMELDETECHNISCHES ZENTRALAMT (FTZ)

Alfred Ochs *In* AGARD Ionospheric Forecasting Jan. 1970 15 p refs (See N70-23112 10-07)

Avail: CFSTI

Research group D 33 (Ionosphere) forms part of the Wave Propagation Department of the Research Institute of the Fernmeldetechnisches Zentralamt (FTZ). It is concerned with a number of research projects in the field of ionospheric wave propagation and solar-terrestrial influences on wave propagation. In the International Ursigram and World-Days Service (IUWDS) the group acts as a Regional Warning Center (RWC) and in the Spacewarn Network as a Satellite Regional Warning Center (SRWC).

In addition, the research group regularly issues monthly, weekly and daily radio predictions and forecasts for radio stations and other radio services. These forecasts are based on a great number of solar, interplanetary and geophysical data, which are furnished by different institutions. The group has some field stations carrying out measurements of ionospheric wave propagation, geomagnetic activity, solar radio emission and cosmic-ray intensity. The measured values are evaluated daily. Some of this work is done by electronic computers. A short description is given of the data evaluation and of the contents and form of the forecasts. Author

N70-23210 National Lending Library for Science and Technology, Boston Spa (England).
THE GENERAL PRINCIPLES OF REGIONAL METALLOGENIC ANALYSIS [OBSHCHIE PRINTSIPY REGIONAL'NOGO METALLOGENICHESKOGO ANALIZA]
Dec. 1969 31 p Transl. into ENGLISH from Materialy Uses. Nauchno- Issled. Geol. Inst. (USSR), v. 22, 1957 p 5–20
(NLL-RTS-5481) Avail: Natl. Lending Library, Boston Spa, Engl.: 40s or 5 NLL photocopy coupons

Metallogenic mineral resources survey technology is discussed with particular emphasis on: (1) classification of geological formations, (2) stages of development of mobile zones, (3) spatial distributions of deposits in folded regions, and (4) platform metallogeny. A table is included showing distribution of mineral deposits during development of mobile belts. E.M.C.

N70-23234# European Space Research Inst., Frascati (Italy).
ELECTROSTATIC INSTABILITIES IN THE BOW SHOCK OF THE MAGNETOSPHERE
B. Bertotti and D. Biskamp *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 41–46 refs (See N70-23229 10-25)
Avail: CFSTI

High resolution magnetic measurements of the magnetic profile in the bow shock have indicated the presence of magnetic structures with a length scale smaller than the ion Larmor radius. This suggests that current instability might explain the high electrostatic turbulence also observed with OGO-E but close comparison of the electrostatic spectrum with the magnetic profiles does not support this idea. Two-ion-stream instability, which in general is not as strong as current instability, is considered in detail but no definite conclusions can yet be made. ESRO

N70-23264# Institut d'Aeronomie Spatiale de Belgique, Brussels.
AERONOMY [L'AERONOMIE]
M. Nicolet 1969 130 p In FRENCH Submitted for publication *Its* Aeronomica Acta No. A-67-1969
Avail: CFSTI

A general review of the upper atmosphere is presented, and the physical and chemical phenomena appearing at different altitudes and seasons are described. The theories based on visual, photographic, spectroscopic, and ionospheric data are discussed. ESRO

N70-23272# Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France).
MATERIAL MOVEMENT OF THE MEDIUM SURROUNDING AN UNDERGROUND NUCLEAR EXPLOSION [MOUVEMENT MATERIEL DU MILIEU ENVIRONNANT UNE EXPLOSION NUCLEAIRE SOUTERRAINE]
Charles Guerrini, and Jean-Louis Garnier Nov. 1969 26 p refs In FRENCH; ENGLISH summary
(CEA-R-3885) Avail: CFSTI

The results of measurements of the mechanical effects in the intermediate zone around underground nuclear explosions in Sahara granite are presented. After a description of the main characteristics of the equipment used, the laws for the acceleration, velocity and material displacement based on the experimental results are discussed. These laws are compared to those published in other countries for nuclear tests in granite, tuff and alluvial deposits. Author (ESRO)

N70-23273# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
EXPERIMENTAL STUDY OF THE EFFECTS OF CHEMICAL EXPLOSIVES IN SOILS: CRATERS, DITCHES AND RELATED PHENOMENA [ETUDE EXPERIMENTALE DES EFFETS D'EXPLOSITS CHIMIQUES DANS DES SOLS: CRATERES, TRANCHEES ET PUENOMENES ASSOCIES]
Paul Perroud et al Jan. 1970 122 p refs In FRENCH; ENGLISH summary Prepared jointly with Grenoble Univ.
(CEA-R-3944) Avail: CFSTI

Single charges of different chemical explosives of 1, 10, 50 and 250 kg were systematically detonated in two different soils: silt and clay, at various bust depths in order to study the laws of cratering and related phenomena. The dimensions of the residual craters were compared, by means of the classical laws of similitude, to previous American and French results. The related phenomena such as ground surface motion, ejection and fall back materials, air blast, etc. were investigated in detail. Some line charges were fired in order to study ditch formation. Author (ESRO)

N70-23356# Dominion Observatory, Ottawa (Ontario).
RECORD OF OBSERVATIONS AT ALERT MAGNETIC OBSERVATORY 1967, VOLUME 38, NO. 4
E. A. Evans 1969 75 p refs
Avail: CFSTI

Data tables presented contain magnetic measurements from a combined magnetic and seismic observatory located in the Northwest Territory of Canada. Photographic variometer and electrical magnetometer measurements are evaluated for baseline values, mean hourly, and annual mean values. G.G.

N70-23364# Institute for Telecommunication Sciences, Boulder, Colo.
NUMERICAL MAPS OF fbEs FOR SOLAR CYCLE MINIMUM
M. Leftin and S. M. Ostrow ESSA Aug. 1969 59 p refs
(ESSA-TR-ERL-124-ITS-87) Avail: SOD $0.60

World numerical maps of lower decile, median, and upper decile values of the monthly distributions of fbEs have been completed for 1964, a solar cycle minimum year. The map representation is quite good, particularly for middle and low latitudes. Comparison of some sample contour maps of fbEs for constant universal time with corresponding contour maps of foEs does not reveal any obvious pattern in the difference between foEs and fbEs with location and time. These contour maps, and sample contour maps of fbEs for constant local time, demonstrate that differences in geographic latitude and geomagnetic field between different locations can account for only part of the world variation of fbEs. This is confirmed by detailed comparison of the diurnal and annual variations of 13 ionosphere stations, which also demonstrates that the independently derived maps form a consistent set. Author

N70-23374# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS [OBSERVATIONS GEOPHYSIQUES] Monthly Bulletin, Aug. 1969
1969 49 p In FRENCH and DUTCH
Avail: CFSTI

Data are given from the Dourbes geophysical observatory in Belgium relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity and cosmic rays for August 1969. ESRO

N70-23428# McGill Univ., Montreal (Quebec). Dept. of Mining Engineering and Applied Geophysics.
INTERPRETATION OF THE ORIGIN OF MICROPULSATIONS USING THE RESPONSE METHOD Final Report, 1 Apr. 1968 – 28 Feb. 1970
L. P. Geldart and C. C. Ku (Grant DA-ARO(D)-31-124-G1000) (AD-698469; AROD-7288-11-EN) Avail: CFSTI CSCL 8/14

The research work carried out under this grant is summarized under two sections. The first deals with the interpretation of

geomagnetic micropulsations using the response method. The approach explains the characteristics of the magnetosphere and the input-output relationship between the solar wind and the observed micropulsations. The second section concerns the phase relation between three orthogonal components of micropulsations. Author (TAB)

N70-23431# Institut d'Aeronomie Spatiale de Belgique, Brussels.
MODEL OF THE POLAR ION EXOSPHERE
J. Lemaire and M. Scherer 1969 36 p refs Submitted for publication *Its* Aeronomica Acta No. 64-1969
Avail: CFSTI

A model of a polar-ion exosphere in which the geomagnetic field lines are open, is developed. The electrostatic electric field in this region was calculated by taking into account two fundamental conditions: (1) quasi-neutrality has to be satisfied everywhere in the exosphere; and (2) evaporative fluxes of electrons and ions have to be equal. The density distributions are calculated for different evaporative models in the case of two (O(+) and e) and three (O(+), H(+) and e) constituents. In addition, the mean velocity, pressure, and temperature distributions of the several constituents are derived. Author (ESRO)

N70-23432# Observatoire du Mont-Gros, Nice (France).
BIBLIOGRAPHICAL STUDY ON THE ABSORPTION PROPERTIES OF OZONE IN THE NEAR ULTRAVIOLET [ETUDE BIBLIOGRAPHIQUE DES PROPRIETES ABSORBANTES DE L'OZONE DANS LE PROCHE ULTRAVIOLET]
Nicole Berruyer-Desirotte [1968] 41 p refs In FRENCH Sponsored partly by ESRO
Avail: CFSTI

In order to observe Orion constellation hot stars of magnitude <10 in the near ultraviolet using balloons (Project Atlas), it was necessary to know the atmospheric absorption at different altitudes. The amount of molecular oxygen was negligible; a bibliography on the absorption properties of ozone in the 2000 -5000 A range is given. ESRO

N70-23462# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
HEAT AND MASS BUDGET OF ARCTIC ICE, SEA ICE DRIFT, MICROMETEOROLOGY, RADIATION, ATMOSPHERIC CHEMISTRY, AND ARCTIC OCEANOGRAPHY Final Report, 30 Sep. 1958 -30 Sep. 1968
Dec. 1969 37 p refs
(Contract Nonr-477(24))
(AD-698305) Avail: CFSTI CSCL 8/10

The report summarizes the research performed during the decade 1958-1968. Research topics include: heat and mass budget of arctic sea ice, sea ice drift, micrometeorology, radiation, atmospheric chemistry, and arctic oceanography. Author (TAB)

N70-23474# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.
THE STRUCTURE OF TEMPERATURE IN THE REGION OF POLAR FRONTJET STREAMS [DIE TEMPERATURSTRUKTUR IM BEREICH VON POLARFRONT STRAHLSTROEMEN]
Friedhold Weber Sep. 1969 87 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-57) Avail: CFSTI

Temperature structures in the region of polar front jet streams were examined by means of flight measurements carried out during transatlantic flights by the Deutsche Lufthansa and by radio soundings. Typical examples show the temperature profiles in the vertical and horizontal directions, as well as the positions of maximum wind velocity in the lows and highs of the upper atmosphere. The zones near the jet fronts or the frontal zones, in which the exchange and transport of air between the stratosphere and troposphere take place, can clearly be recognized from the vertical cross sections of the potential temperatures. The airborne measurements of the temperature gradients are reproduced in tabular form. Author (ESRO)

N70-23539# National Physical Lab., New Delhi (India). Radio Propagation Unit.
SOLAR AND GEOPHYSICAL DATA, PART 2
Oct. 1969 12 p
(RRC-A172-PT-2) Avail: CFSTI

Tabulated solar and geophysical data obtained with vertical incidence soundings technique from Indian stations are compiled. Sunspot, solar flare, solar flux, and magnetic storms data are included. Author

N70-23541 *# National Academy of Sciences-National Research Council, Washington, D.C. Div. of Engineering.
USEFUL APPLICATIONS OF EARTH-ORIENTED SATELLITES: GEODESY-CARTOGRAPHY, PANEL 13
Frederick J. Doyle (Raytheon Co., Alexandria, Va.), William M. Kaula (Calif. Univ., Los Angeles), Charles A. Lindquist (Smithsonian Astrophysical Obs.), Ivan I. Mueller (Ohio State Univ.), John V. Sharp (IMB, Kingston, N.Y.) et al 1969 53 p refs
(Contract NSR-09-012-909)
(NASA-CR-109351) Avail: CFSTI CSCL 08E

A systems approach to the technical feasibility and cost of a proposed space geodesy-cartography program is considered. The current status of the dynamic and geometric satellite programs is outlined with proposed photographic systems for the Apollo Applications Program and multiband synoptic photography. Justification for the proposed system is given along with a description of the cartographic satellites. J.M.C.

N70-23607# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
VARIATIONS IN ISOTOPIC ABUNDANCES OF STRONTIUM, CALCIUM, AND ARGON AND RELATED TOPICS Annual Progress Report, 1969
1 Dec. 1969 157 p refs
(Contract AT(30-1)-1381)
(MIT-1381-17; APR-17) Avail: CFSTI

Geochronological studies based on measurements of isotropic abundances in metamorphic rocks in northeastern Newfoundland, northern Appalachians, Sierra Leone, and eastern Liberia are presented. Continental accretion in Laurasia based on radiometric ages was investigated. The Rb/Sr ratio age estimations were made for crater rocks of possible impact origin, for whole-rock dating of diabase dikes, and for percambrian iron formations of the Canadian shield. Sr-86/Sr-87 ratios in pyroxene granulites from ten world-wide locations are reported. Techniques and standards for Rb/Sr isotopic determinations are discussed. A bibliography of age data on continental basement rocks is given as well as reprints of miscellaneous papers on geochronology research. Abstracts of five papers in this field presented at international meetings are reprinted. NSA

N70-23651# Geological Survey, Washington, D.C.
SIX NEW PALEOZOIC AND MESOZOIC FORMATIONS IN EAST-CENTRAL ALASKA
Earl E. Brabb 1969 25 p refs *Its* Geol. Surv. Bull. No. 1274-I
Avail: SOD $2.50

Six of 25 new map units established by regional geologic mapping in the Charley River and Eagle quadrangles are formally defined and named as follows: Ford Lake Shale (Upper Devonian to Upper Mississippian), Step Conglomerate (Permian), Glenn Shale (Middle Triassic to Lower Cretaceous), and the Kennan Quartzite, Biederman Argillite, and Kathul Graywacke - three formations within the Lower Cretaceous Kandik Group. Author

N70-23661# Dominion Observatory, Ottawa (Ontario).
A SYSTEM OF MAGNETIC ANALYSIS FOR IONOSPHERIC CURRENTS, VOLUME 39, NO. 2

Ralph D. Hutchison 1970 19 p refs
Avail: CFSTI

The magnetic field of a circular-line current can be expressed (in complete elliptic integrals) so that there are no regions of mathematical failure or weakness. Such an expression is set up in spherical coordinates suitable to the study of ionospheric currents. It is shown that magnetic observations on the surface of the earth can then be used analytically to define current strength, height of current path, and curvature of current path. The analytical system is capable of development for coping with ribbon currents or more elaborate cases. Author

N70-23721# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.

A MODEL FOR THE SEMIANNUAL EFFECT APPEARING IN THE DRAG DATA OF SATELLITES IN ECCENTRIC ORBITS

Albert D. Anderson Oct. 1969 36 p refs
(LMSC-6-78-69-37) Avail: CFSTI

A model for the semi-annual effect is presented, based on latitudinal density distributions for both hemispheres and every month. The interaction of selected eccentric-orbit satellites with these density distributions is analyzed. It is shown that some satellites will exhibit a marked semi-annual effect as a result of latitudinal density variations. A comparison of calculations from the model with independent satellite drag data indicates good agreement in the months from May–September. Contrary to Jacchia et al., the deep midyear minimums of the semi-annual effect do not occur simultaneously for all satellites. The model presented in this paper predicts an even larger amplitude than that of Secor 6 for satellite Injun 3 (perigee altitude 249 km) which is supported by drag data. However, the model evidently does not provide a complete explanation of the semi-annual effect. Apparently, heating associated with geomagnetic perturbations plays a major role in the semi-annual effect around the equinoxes. Author

N70-23732# Sea Farm Research Foundation, Inc., Waltham, Mass.

STUDY OF VARIATIONS OF THE GEOMAGNETIC FIELD AND RELATED SOLAR AND TERRESTRIAL PHENOMENA Final Report, 16 Mar. 1967 –13 Sep. 1969

John H. Frey 13 Oct. 1969 180 p refs
(Contract F19628-67-C-0307)
(AD-698353; AFCRL-69-0442) Avail: CFSTI CSCL 8/14

During the period of the contract, geomagnetic variations having durations ranging from 0.02 seconds to several days have been investigated, and mathematical procedures for spherical harmonic analysis of world-wide geomagnetic data have been prepared. This investigation included the collection of data by the operation of field recording stations and by obtaining world-wide observatory data from the World Data Center; the reduction of the data to digital and graphic presentations suitable for further study; and the analysis of the reduced data to obtain information on the nature and origins of the geomagnetic variations and their relationship to solar and other geophysical phenomena. In the course of the investigation specialized electronic instruments have been designed and constructed. Author (TAB)

N70-23758# Joint Publications Research Service, Washington, D.C.

PULSE OF THE EARTH'S MAGNETOSPHERE

V. A. Troitskaya 19 Feb. 1970 18 p Transl. into ENGLISH from Priroda (Moscow), no. 12, 1969 p 9–17
(JPRS-49889) Avail: CFSTI

The use of low- and high-frequency radio waves is described for probing the plasma in the inner space of the earths magnetosphere. The processes taking place during interaction of waves and particles in the vicinity of the earth can be determined by micropulsations of the earth's magnetic field. The micropulsations are recorded in a curve which resembles a string of beads and the spikes of such pulsations are called pearls. Experiments are described for recording the bursts of irregular fluctuations of the magnetosphere at magnetic conjugate points. It is shown that the modulation of stable oscillation conditions occurs simultaneously throughout the earth and that the global variations in the amplitude of such oscillations are linked with the orientation of the interplanetary magnetic field. R.B.

N70-23765# Institut Royal Meteorologique de Belgique, Brussels.

IONOSPHERIC AND COSMIC RAY OBSERVATIONS [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE] Monthly Bulletin, Aug. 1969

1969 29 p In FRENCH and DUTCH
Avail: CFSTI

Ionospheric data tables for August 1969 from Dourbes, Belgium, giving hourly values of the critical maximum usable and minimum reflection frequencies, together with the virtual heights of the E and F regions etc. are presented. Variations of the neutron component intensity of the secondary cosmic radiation are also listed. ESRO

N70-23766# Institut Royal Meteorologique de Belgique, Brussels.

IONOSPHERIC AND COSMIC RAY OBSERVATIONS [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE] Monthly Bulletin, Sep. 1969

1969 23 p In FRENCH and DUTCH
Avail: CFSTI

Ionospheric data tables for September 1969 from Dourbes, Belgium, giving hourly values of the critical maximum usable and minimum reflection frequencies, together with the virtual heights of the E and F regions etc. are presented. Variations of the neutron component intensity of the secondary cosmic radiation are also listed. ESRO

N70-23795# Bureau of Mines, College Park, Md. Applied Physics Research Lab.

GEOMETRIC RELATIONSHIPS BETWEEN GEOLOGIC STRUCTURE AND GROUND STRESSES NEAR ATLANTA, GEORGIA

Carl E. Norman Apr. 1970 28 p refs
(BM-RI-7365) Avail: Issuing Activity

An investigation of geologic structure on macroscopic, mesoscopic, and microscopic scales was conducted on near-surface igneous and metamorphic rocks in which the existing stress field was determined by in situ methods. A consistent NE-SW orientation of the maximum compressive stress in the horizontal plane at four of five test localities appears due to the intrusion of NW-trending diabase dikes. Structural features at the mesoscopic scale show no consistent directional relationship to determined stress directions. Petrofabric diagrams of open microfractures show preferred orientations, but these are not consistently related to the orientations of larger structural features, such as joints, foliation, or mineralized shear zones. However, at five of six test sites the preferred direction of microfractures occurs nearly perpendicular to the maximum principal stress directions. The results suggest that the open microfracture subfabric may provide a means for gaining information on the directional properties of stress fields. Such information can be obtained from oriented cores taken from holes which exceed the approximate 100-foot depth to which other in situ methods are presently limited. Author

N70-23806# Bonn Univ. (West Germany). Inst. fuer Physikalische Chemie.

SIMULATION OF PHYSICO-CHEMICAL PROCESSES IN THE HIGHER ATMOSPHERE. PART 1: DESCRIPTION OF TEST FACILITIES AND MEASURING APPARATUS [SIMULATION VON PHYSIKALISCH-CHEMISCHEN VOREAENGEN IN DER HOEHEREN ATMOSPHAERE. 1. TEIL: BESCHREIBUNG DER VERSUCHSANLAGEN UND DER MESSAPPARATUREN]

K. H. Becker, A. Elzer, W. Groth, P. Herteck, and D. Kley Dec. 1968 23 p refs In GERMAN
(SHA/I) Avail: CFSTI

A high altitude simulation chamber and the associated equipment to be used in investigations of chemical reactions between atmospheric constituents is described in detail. The vacuum chamber can be heated to 300 C by means of an oil circuit heating system and is equipped with atomic and molecular gas inlets. The measurements cover the integral light intensity in the visible, UV and IR regions, the spectral distribution, and the quantitative analysis of the permanent gases by means of a mass spectrometer, along with the atomic concentration, and the total chamber pressure. ESRO

N70-23816# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
THE ELECTRIC FIELD EXISTING AT STRATOSPHERIC ELEVATIONS AS DETERMINED BY TROPOSPHERIC AND IONOSPHERIC BOUNDARY CONDITIONS
W. Atkinson, S. Lundquist, and U. Fahleson Nov. 1969 22 p refs Prepared jointly with Inst. of High Voltage Res.
(Rept-69-35) Avail: CFSTI

The feasibility of inferring ionospheric electric fields from measurements at balloon altitudes has been studied by analytical and numerical analysis, using a two-dimensional model atmosphere with exponentially varying conductivity, and taking into account electric fields of tropospheric origin. Author (ESRO)

N70-23826# Bonn Univ. (West Germany). Inst. fuer Physikalische Chemie.
SIMULATION OF PHYSICO-CHEMICAL PROCESSES IN THE UPPER ATMOSPHERE. PART 2: CHEMILUMINESCENCE REACTIONS OF AERONOMICAL IMPORTANCE [SIMULATION VON PHYSIKALISCH-CHEMISCHEN VORGAENGEN IN DER HOEHEREN ATMOSPHAERE. 2. TEIL: (CHEMILUMINESZENZREAKTIONEN VON AERONOMISCHER BEDEVTUNG]
K. H. Becker, A. Elzer, W. Groth, and D. Kley Dec. 1968 27 p refs In GERMAN Sponsored partly by Bundesmin. fuer Wiss. Forsch. and Nordrhein-Westfael. Landesamt fuer Forsch.
(SHA-2) Avail: CFSTI

Laboratory experiments were conducted on the chemiluminescence of atomic nitrogen and nitrogen monoxide. The intensity and the spectral distribution of several types of afterglow were investigated, and the extinction curves of the chemiluminescence and the wall recombination coefficient for nitrogen atoms were determined. The dependence of chemiluminescence on total pressure was also measured, and the luminescence of nitrogen monoxide was investigated. ESRO

N70-23854# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
CONTINUOUS EMISSION OF THE TERRESTRIAL ATMOSPHERE AT 9.6 MICRONS [EMISSION CONTINUE DE L'ATMOSPHERE TERRESTRE A 9.6 MICRONS]
E. Vigroux Dec. 1969 14 p refs Transl. into ENGLISH from Ann. Geophys. (Paris), v. 1 1959 p 453-460 Prepared for Lincoln Lab., MIT
(AZT-70-41-FRLL) Avail: CFSTI

The emission spectra of the terrestrial atmosphere show a continuous emission in the spectral region near 9.6 microns. Ascribing this emission to water vapor allows computation of the absorption factor. Absorption spectra in the F band of H2O are used to determine the water content, as necessary for the computation. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N70-22545# Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
ON THE STRUCTURE OF HIGH-FREQUENCY TURBULENCE IN A TIDAL ESTUARY Technical Report
William J. Wiseman, Jr. Nov. 1969 85 p refs
(Contract Nonr-4010(11))
(AD-698814; TR-59; REF-69-12) Avail: CFSTI CSCL 8/3

As part of a comprehensive program to study naturally occurring fluid motions in the marine environment at all time scales a meter has been developed which is capable of sensing high-frequency turbulence. This meter introduces a number of new features to the field of current measurement techniques. It does not disturb the fluid at the point of measurement. It measures the entire velocity vector. It takes a vector average of its measurements. The meter has been laboratory tested and used in the field. It was demonstrated that the current meter has the capability of operating effectively in the presence of a wave field and may be useful in the study of such types of fluid motion. TAB

N70-22554# Boeing Scientific Research Labs., Seattle, Wash.
OPTICAL TACHOMETRY FOR MONITORING NMR SAMPLE SPINNING RATES
T. J. Pratt and S. D. Brooks Sep. 1969 13 p refs
(AD-698820; D1-82-0887) Avail: CFSTI CSCL 14/2

A simple optical tachometer utilizing fiber optics and solid state electronics has been designed and constructed in order to monitor sample turbine spin speeds on a Varian HA 100D nuclear magnetic resonance spectrometer. By use of a bifurcated fiber optical path, light is transmitted to the turbine strobe, modulated, and returned to the detector within the same plastic-sheathed glass fiber bundle. Rotational information can thus be retrieved without disturbing the magnetic field or sample environment. Employment of this technique may be extended to other applications where conventional tachometry is impractical. With a properly tuned magnet, optimum spectral resolution was observed to be independent of sample spinning rates of 10 to 30 rps. Beyond this rate, the deteriorated resolution was attributed to mechanical noise from precession of an unbalanced sample tube or turbine assembly. Author (TAB)

N70-22557# California Univ., Berkeley. Lawrence Radiation Lab.
SOME APPLICATIONS OF TRANSMISSION ELECTRON MICROSCOPY
G. Thomas Jun. 1969 40 p refs
(Contract W-7405-eng-48)
(UCRL-19021) Avail: CFSTI

Basic techniques of transmission electron microscopy are outlined for determining the microstructure of materials. General methods of identification are discussed with respect to two or more phase systems resulting from phase transformations, excluding martensites. The structure of most commercial alloys is characterized in terms of alloy composition and treatment. In structural analysis equal attention is given to the diffraction pattern, corresponding bright and dark field images, and their changes upon tilting. Typical examples are given for analysis of multiphase structures. NSA

N70-22573*# Michigan Univ., Ann Arbor. Aerospace Engineering, Meteorology and Oceanography Dept.
A NEUTRAL AND ION MASS SPECTROMETER FOR ENVIRONMENTAL GAS COMPOSITION OF THE APOLLO TELESCOPE MOUNT, EXPERIMENT NO. T-030 Final Report
Richard J. Leite, Conrad J. Mason, Barry B. Hinton, and Roland D. Kistler Dec. 1969 65 p
(Contract NAS8-21448)
(NASA-CR-109253; Rept-01747-1-F) Avail: CFSTI CSCL 14B

The mass spectrometer to determine the composition and distribution of the gaseous contaminates originating on or within the spacecraft is described. A mass range of 100 atomic mass units is swept exponentially in approximately 12.5 seconds. The 0 to 5 volt analog output signal is produced by a logarithmic electrometer. The electronic components are entirely solid state

devices. A description of the accompanying ground support equipment and a set of operating instructions are included. Recommendations related directly to the ATM operations and requirements, including environmental test operations, are given. Author

N70-22588# Rome Air Development Center, Griffiss AFB, N.Y.
AR-109 VIEWER-PRINTER, PROJECTION, PHOTOGRAPHIC Technical Report
Warren M. Emlen Nov. 1969 43 p refs
(AD-698338; RADC-TR-69-284) Avail: CFSTI CSCL 14/5

The advent of more sophisticated reconnaissance data collection systems, which provide more data of higher resolution, has necessitated the development of a combination direct/rear projection viewer and a quick printer. This report covers the development and operational test of the unit, including a fairly detailed description of its operational capabilities. The viewer provides 2.5x, 5x, 10x, and 22.6x magnifications in the rear projection mode, and a Zoom 70/240 provides detailed viewing on the external light table. The printer, which connecrs to the left side of the viewer, provides a 20 x 20 inch briefing-quality enlarged positive print (from a positive transparency on the light table) in about 60 seconds. Author (TAB)

N70-22629# Illinois Univ., Urbana. Dept. of Civil Engineering.
ANALYTIC AERIAL TRIANGULATION FOR HIGHWAY LOCATION AND DESIGN
H. M. Karara and G. W. Marks Jul. 1969 239 p refs /ts Program Series-100 and Photogrammetry Series-22
(PB-186495) Avail: CFSTI CSCL 13B

The use of photogrammetry in the acquisition of topographic data to be utilized for the design of engineering projects has developed rapidly within the past decade. With the availability of high speed electronic digital computers, analytical aerotriangulation has appeared as a solution with great potential. In the investigation reported on the application of analytical aerial triangulation to highway location and design was studied. Author (USGRDR)

N70-22646# Sandia Corp., Albuquerque, N. Mex.
A LEAD ZIRCONATE TITANATE STRESS TRANSDUCER Development Report
R. E. Hutchison Jul. 1969 27 p refs
(PB-187225; SC-DR-69-356) Avail: CFSTI CSCL 09A

The report describes a ferroelectric ceramic unidimensional stress transducer. The output current is shown to be proportional to a time-dependent function of the stress on the front electrode for one wave transit through the ceramic element. Experimental data are presented which verify the transducer response to initiating stress as consistent with the mathematical description. The useful dynamic range extends to approximately 1 kbar in the ceramic. The response is shown to be adequate for detection of mircrosecond stress time profiles with a sensitivity of 46 volts/kbar across a 50-ohm cable termination. Details are given on the design of a compensating termination which effectively cancels the time-dependent response function to unity. Author (USGRDR)

N70-22676*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 9 MULTISPECTRAL PHOTOGRAPHIC INFORMATION
John L. Kaltenback, comp. Washington Apr. 1969 38 p refs
(NASA-TM-X-1957; S-226) Avail: CFSTI CSCL 14E

The NASA Experiment SO65 multispectral photography flown on the Apollo 9 mission provided orbital photography of the earth. The photography was taken by four cameras, each of which contained a different film-filter combination. Special color viewing and reproduction systems are being used to determine the use and value of multispectral photography to the earth resources disciplines and to apply these findings to the design of future imaging systems. Author

N70-22694# Sandia Corp., Albuquerque, N. Mex. Technical Translation Service.
PARTICLE SIZE SPECTROMETRY OF AEROSOLS THROUGH LIGHT SCATTERING IN A LASER BEAM [TEILCHENGROSSEN-SPEKTROMETRIE VON AEROSOLEN DURCH LICHTSTREUUNG IN EINEM LASERSTRAHL]
W. Jacobi et al 10 Nov. 1969 27 p refs Transl. into ENGLISH from Hahn-Meitner-Inst. fuer Kernforschung Berlin Rept. (Germany), Nov. 1967 28 p Sponsored by AEC
(PB-187705T; SC-T-69-1052) Avail: CFSTI CSCL 14B

A particle size spectrometer for aerosols is described, which measures the light scattered by single particles in a laser beam. The device was calibrated with monodisperse Latex-aerosols. The spectrometer uses a small scattering volume (0.05 cu mm) and has good size resolution (3–12%, depending on particle size). The lowest detectable particle diameter is 0.3 micrometers. Author (USGRDR)

N70-22714# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
EVALUATION OF A TIME OF FLIGHT (TOF) MASS SPECTROMETER FOR ANALYSIS OF SODIUM
G. B. Barton Nov. 1969 34 p refs
(Contract AT(45-1)-1830)
(BNWL-1208) Avail: CFSTI

A Model MA-1 time of flight mass spectrometer was tested for possible use in the FFTF. The limiting sensitivity of the mass spectrometer was found to be adequate for FFTF Na cover gas analyses. Advantages and disadvantages are discussed. NSA

N70-22753*# Thermal Systems, Inc., St. Louis, Mo.
A PROGRAM OF PROOF TESTS OF THE DUAL ABLATION MEASUREMENT TECHNIQUE Final Report
Jan. 1970 128 p
(Contract NAS1-8221)
(NASA-CR-66857) Avail: CFSTI CSCL 14B

The measurement of ablation by nucleonic techniques was proved not only feasible but realizable with state-of-the-art, commercially available hardware. An integrated program consisting of theoretical analysis, test model design and fabrication, instrumentation evaluation, nuclear calibration tests, plasma jet testing, and data reduction and correlation is summarized. The theoretical portion of the program determined those parameters significantly affecting measurement technique and its associated accuracy: signal attenuation, isotope activity ratio, and isotope activity levels. In a series of plasma jet tests simulating vehicle entry environments, sensors fabricated of two parent heat shield materials (phenolic nylon and phenolic graphite) and impregnated with two radioactive tracers (In-114m and ZrNb-95) were effectively utilized to trace char and char-virgin material interface recessions. Author

N70-22767# Gulf General Atomic, San Diego, Calif.
RELIABILITY OF HIGH-TEMPERATURE THERMOCOUPLES IN IRRADIATION CAPSULES
N. L. Sandefur, F. D. Carpenter, R. J. Grenda, and J. S. Steibel 18 Sep. 1969 33 p Presented at Symp. on Develop. in Irradiation Testing Technol., Sandusky, Ohio, 9–11 Sep. 1969 Submitted for publication
(Contract AT(04-3)-167)
(GA-9653; CONF-690910-7) Avail: CFSTI

A study of thermocouple behavior and reliability in irradiation capsules were conducted. The investigation covered 16 instrumented (lead-tube type) capsules, which contained a total of 200 Chromel-Alumel and tungsten-rhenium sheath-type thermocouples. The history of each thermocouple was recorded from the time of receipt to insertion in an experiment and during its operating life within the irradiation capsule. The test data were tabulated into a computer code designed to evaluate thermocouple performance as a function of: (1) neutron exposure; (2) operating temperature; (3) time at temperature; (4) thermocouple type (Chromel-Alumel,

tungsten-rhenium); (5) type of hot junction (capped or plugged, grounded, isolated); (6) manufacturer; (7) commercial construction versus construction to Gulf General Atomic specification; and (8) position of thermocouple within the capsule. The computer analyses revealed that a 30% to 40% thermocouple failure rate can be expected under any set of conditions examined. The probability of failure was greater with increasing neutron exposure and longer times in the reactor. Author (NSA)

N70-22768# Battelle-Northwest, Richland, Wash.
EFFECTS OF IONIZING RADIATION ON STABILIZED PHOTO OPTICS
J. H. Kleinpeter and W. J. Clare Oct. 1969 30 p refs
(Contract AT(45-1)-1830)
(BNWL-1137) Avail: CFSTI

Several nonbrowning lenses were tested for useful life in a radiation field. Included in the test were a 30–150 mm variable focal length or zoom lens, fixed focal-length lenses in 1/2-in. f/2.5, 1-in. f/2.5 and 4-in. f/2.5 sizes, and suitable controls of conventional glass. All the nonbrowning lenses were useful beyond 10 to the 9th power rad total integrated dose, and the 1-in. f/2.5 was usable after 2 × 10 to the 10th power rad. Coupons of the glasses used in the manufacture of these lenses were irradiated and tested for changes in refractive index and visible light transmission. Author (NSA)

N70-22781# California Univ., Livermore. Lawrence Radiation Lab.
AUTOMATED INSTRUMENTATION SYSTEM FOR MASS SPECTROMETRIC GAS ANALYSES
Richard W. Crawford, Ronald K. Stump, and Klaus Ernst 27 Aug. 1969 17 p Sponsored by AEC
(UCRL-50738) Avail: CFSTI

An automated instrumentation and data acquisition system that analyzes gases by mass spectrometry is described. This system continuously monitors chemical reactions in several closed reaction vessels by automatically sampling and analyzing the gas compositions at predetermined, but variable, time intervals. Mass spectral data are recorded on an oscillograph recorder. Simultaneously, mass-number and peak-height information is digitized, printed out, and punched on a fast paper-tape punch. Author (NSA)

N70-22784# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
IMPROVED URANIUM COLORIMETER
James S. Stutheit Jun. 1969 12 p refs
(Contract AT(07-2)-1)
(DP-1193) Avail: CFSTI

Savannah River Plant colorimeters used to monitor continuously liquid streams containing 0 to 10 grams of uranium per liter of solution have been redesigned to give uranium analysis correct within + or − 0.5 grams/liter. In the redesign, solid state logarithmic amplifiers, magnetic amplifiers, and closely regulated power supplies were used to achieve accuracy and stability. Meter and recorder indications were made linear to read in grams/liter of uranium. The optical portion was modified so the colorimeter could be calibrated without removing the sample cell. Author (NSA)

N70-22828 Catholic Univ. of America, Washington, D.C.
MEASUREMENT AND ANALYSIS OF VIBRATION BY OPTICAL HETERODYNING
Francis Joseph Eberhardt (Ph.D. Thesis) 1969 84 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-19746

An optical heterodyne system has been developed and tested for the measurement and analysis of transient and random vibration. One component of laser light is frequency shifted by ultrasonic diffraction and is heterodyned with light which has been phase modulated by the motion of a surface. The modulation is thus transferred to the radio heterodyne frequency and subsequent detection results in an output voltage which is linearly related to the time varying amplitude of surface motion. A calibration technique is described for obtaining the absolute amplitude and tests of this technique have been carried out over a range of 3 - 3000 A and frequencies from 500 to 9000 Hz. The upper limit is determined by the frequency-amplitude product of the motion which determines the necessary bandwidth of the detector. Measurement of spatial cross-correlation functions is demonstrated using two heterodyne detectors. Dissert. Abstr.

N70-22852*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY INSTRUMENTS
In its Space Programs Sum. No. 37–59, Vol. 3 31 Oct. 1969 p 1–10 refs (See N70-22851 10#-34)
Copyright. Avail: CFSTI CSCL 14B

The development of a urine analyzer for the quantitative determination of creatinine, creatine and calcium as part of the Biosatellite Program is described. The mechanical and electrical details of this instrument are discussed and the chemistry is to be published at a later date. This article demonstrates that the modified Jaffe reaction can be made more sensitive to creatinine by the employment of ethanol as a solvent for picric acid crystals. Author

N70-22853*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE INSTRUMENTS
In its Space Programs Sum. No. 37–59, Vol. 3 31 Oct. 1969 p 11–13 (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 14B

High-resolution solid-state detectors are replacing NaI (Tl) scintillators in many gamma-ray spectroscopy applications. The resolution of a 30 cubic cm coaxial Ge (Li) detector is typically 3 keV. The resolution of a good 3 × 3 NaI (Tl) scintillator photomultiplier assembly at the 0.662 Mev CS137 energy is approximately 46 keV. Field effect transistor (FET) first-stage circuitry has been employed in uncooled commercial preamplifiers to reduce preamplifier noise to a level of approximately 2.5 keV. This noise level applies to operation with 30 cubic cm solid-state detectors which have a capacity of approximately 30 pF. At a noise level of 2.5 keV, the preamplifier contribution to system noise is approximately the same as the detector contribution. In order to further reduce preamplifier noise, cryogenic cooling of the first stage must be employed. Author

N70-22898# Oceanics, Inc., Plainview, N.Y.
AN ENGINEERING GUIDE TO SPECTRAL ANALYSIS Final Report, 1 Jul. 1962–31 Oct. 1967
Wilbur Marks Jun. 1969 80 p refs
(Contract Nonr 3961(00))
(AD-698837; TR-69-63) Avail: CFSTI CSCL 14/2

The document is aimed at providing insight into the various aspects of spectral analysis of samples drawn from populations generally representing oceanographic and geophysical events. Hypothetical spectra, with more or less typical shapes, are developed and from these are generated a series of time histories. The records are subjected to spectral analysis with systematic variation of number of points, sampling interval and number of lags. From the results of computing several hundred spectra, it is seen that estimation of the true spectrum is affected in various ways by: length of record, resolution, aliasing, spectral window and confidence bounds. Since it is impossible to specify a set of rules for every conceivable spectral density calculation, this paper shows how consideration of the elements mentioned above leads to design of the analysis experiment most likely to extract maximum reliable information from the data. In general, the work described here applies to stationary processes, but the treatment of non-stationary events is also discussed briefly. Author (TAB)

N70-22914*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HEAO BASELINE EXPERIMENTS, APPENDIX A
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 25 p refs (See N70-22901 10-31)
Avail: CFSTI CSCL 14B

A technical description is given of the six baseline experiments to be included in the HEAO program. The scientific objectives and physical description of the equipment are provided for each of the experiments, which include a large area X-ray detector, a low-energy gamma ray detector, a medium-energy gamma ray detector, a gamma ray telescope, a primary cosmic ray electron detector, and a cosmic ray calorimeter. Scan rate considerations for the program are also discussed. R.B.

N70-22940# Sandia Corp., Albuquerque, N. Mex.
LASER INTERFEROMETER DETERMINATION OF THE DYNAMIC RESPONSE OF ALUMINUM TO INTENSE ELECTRON PULSES Research Report
F. C. Perry Sep. 1969 16 p refs
(PB-187235; SC-RR-69-500) Avail: CFSTI CSCL 14B

A description is presented of a technique to measure the dynamic response of solids to energy deposition by electron beams. A laser interferometer is used to obtain the rear surface displacement as a function of time of a specimen heated by an electron pulse. Measurements of the one-dimensional elastic response of aluminum and a thermoelastic calculation provided a value of the room temperature Gruneisen parameter, for T6-6061 aluminum of 2.00 plus or minus 15 percent. Calculations using the code Wondy confirmed the result. The laser interferometer technique provides a useful research tool for investigating both material properties and electron beams themselves. Author (USGRDR)

N70-22958*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ATS-E MAGNETIC FIELD MONITOR INSTRUMENTATION
T. L. Skillman Jan. 1970 34 p refs
(NASA-TM-X-63852; X-645-70-54) Avail: CFSTI CSCL 14B

Instrumentation, tests and calibration, and data outputs of the magnetic field monitor (MFM) are described. The position of the MFM sensor and electronics package on the ATS-E spacecraft, and the fluxgate magnetometer coordinate system are illustrated. Rapid satellite spin rates and their effects on the telemetry outputs of the MFM are discussed. Four ground stations in Manitoba provide magnetograms for comparison with ATS-E data. M.H.E.

N70-22965# Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex.
DENSITY DETERMINATION BY A WATER FILLED ENCLOSED VESSEL
L. W. Black Oct. 1969 7 p
(Contract DA-11-173-AMC-487(A))
(PB-187708; MHSMP-10) Avail: CFSTI CSCL 14B

The paper defines a method for determining the density of an object by water displacement within an enclosed vessel. Author (USGRDR)

N70-23106# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SYSTEM FOR TESTING PRESSURE PROBES USING A SIMPLE SINUSOIDAL PRESSURE GENERATOR
Ted W. Nyland and David R. Englund, Jr. Washington Apr. 1970 11 p refs
(NASA-TM-X-1981) Avail: CFSTI CSCL 14B

A simply built and easily operated pressure generator is described which is capable of producing sinusoidal pressures at frequencies ranging between 300 and 5000 Hz and peak-to-peak amplitudes to 5.6 psi (3.9 N/cm^2). The generator design is based on the Galton tube which is a resonant tube driven by an annular air jet. Instrumentation for making frequency, amplitude, and phase angle measurements is described. A typical data plot of the frequency response of a pressure probe is given. Author

N70-23208*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF TUBING EFFECTS ON AMPLITUDE FREQUENCY RESPONSE OF PRESSURE SENSING SYSTEMS USING NONRESONANT TERMINATIONS
Walter E. Wilhelm Washington Apr. 1970 14 p refs
(NASA-TM-X-1988; E-5454) Avail: CFSTI CSCL 14B

An investigation was made to determine the effect of tube diameter, tube length, type of material, and area change on the amplitude frequency response of dynamic pressure sensing devices. The devices were mounted a finite distance from the point of disturbance, and nonresonant tube terminations were employed. Author

N70-23209*# General Electric Co., Philadelphia, Pa.
A SPACECRAFT GAS JET LEAK DETECTION SYSTEM Final Report, Jun. - Oct. 1969
8 Jan. 1970 43 p Prepared for JPL
(Contracts NAS7-100; JPL-952578)
(NASA-CR-109322; DIN-69SD4378) Avail: CFSTI CSCL 14B

The feasibility of developing a solenoid valve failure detection system requires the addition of a radioactive gas to the propellant tank of an attitude control system. The results of measurements of 10% C(14)O leak rates near 1 cu cm/hr with an avalanche detector are presented. Author

N70-23217# European Space Research and Technology Center, Noordwijk (Netherlands).
COMPARISON OF DETECTORS FOR SOLAR SIMULATION INTENSITY MEASUREMENTS
G. Saenger and W. A. Shickle Jun. 1968 44 p refs
(ESRO-TN-31) Avail: CFSTI

Tests were conducted to compare the detectors used as standards to measure the lamp intensity in thermal vacuum tests on the ESRO satellites. The detectors used fall into two classes: light sources and fluxmeters. The light sources are an Osram lamp and a General Electric quartz-iodine lamp. The fluxmeters considered are: Kipp thermopile, Eppley thermopile, solar cells, and black plate with internal heater. Three experiments were carried out in the ESTEC Heat Balance Facilities, one in the 1.5-metre HBF2 and two in the 2-metre HBF3. In addition a test was carried out in the Alcatel chamber in air and vacuo to investigate the effect of water vapour absorption in air. Test results are tabulated and each test is discussed. Author (ESRO)

N70-23260*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A LARGE AREA HIGH RESOLUTION COSMIC RAY CHARGE COMPOSITION DETECTOR
J. F. Ormes, V. K. Balasubrahmanyan, R. D. Price, M. J. Ryan, and R. F. Silverberg (Maryland Univ.) Mar. 1970 24 p refs
(NASA-TM-X-63863; X-661-70-108) Avail: CFSTI CSCL 14B

A detector designed to study the charge composition of the primary cosmic radiation in the range Z = 3 to 30 has been flown on balloons during 1969. The flight is part of a program to study the charge composition in the energy range 10 to 100,000 GeV. The telescope consists of a four fold charge measurement using two plastic scintillators, a Cerenkov detector and a mosaic CsI (Na) detector. The intrinsic limitations on charge resolution due to statistical fluctuations in energy loss are approached by correcting the pulse heights for geometrical effects. This is accomplished by calibrating the detector response in flight using a spark chamber to determine the particle trajectories. Author

N70-23326# Army Foreign Science and Technology Center, Washington, D.C.
AERIAL ANALYSIS OF VEGETATION IN ARID ZONES

B. V. Vinogradov 18 Nov. 1969 360 p refs Transl. into ENGLISH of the book "Aerometody Izucheniya Rastitelnosti Arionykh Zon" Moscow, Nauka, 1966 p 1–503
(AD-698850; FSTC-HT-23-735-68) Avail: CFSTI CSCL 14/5

The report is a complete survey of the application of aerial photography to the analysis of vegetation in arid zones. Techniques for photographing, identifying, analyzing and interpreting vegetation at all photographic scales from 1:3,00 and larger to 1:50,000 and smaller are discussed. The technique which receives primary emphasis for the photographic interpretation of vegetation over wide areas is the selection of key sites, the preparation of aerial photographic interpretation standards and the extrapolation of these standards from the key sites over the entire area. Almost 400 different plants are mentioned by name, and there is an extensive bibliography. Areas discussed are primarily within the bounds of the Soviet Union, with some references to Africa and the Near East. Author (TAB)

N70-23328# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVELOPMENT OF INFRARED SPECTROMETERS IN RECENT YEARS
I-shan Cheng 5 Aug. 1969 32 p refs Transl. into ENGLISH from K'O Hsueh i Ch'i (China), v. 4, no. 4, 1966 p 145–154
(AD-698520; FTD-HT-23-1299-68) Avail: CFSTI CSCL 14/2

The paper outlines the technical development of infrared spectrometers, with emphasis on the characteristics and useful values of modern wide-angle prisms, simplified prisms, light filter-grating instruments, and prism-grating instruments. In addition, the paper briefly discusses the operational characteristics of infrared spectrometers, the spectrometric pattern spacing of grating instruments, the order of spectrums, the change of such order, and the scanning of linear wave lengths. Furthermore, the paper also explains the trend of development in infrared spectrometers. Author (TAB)

N70-23333# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
NOTES ON THE ELECTRONIC MICROSCOPE, NO. 4 [APPUNTI DI MICROSCOPIA ELETTRONICA, NO. 4]
D. Steve Bocciarelli 15 May 1969 57 p In ITALIAN; ENGLISH summary
(ISS-69/22) Avail: CFSTI

In this report the practical use and operation of the electron microscope is considered. The measurement of resolving power and the calibration of magnification in different working conditions are described. Moreover the possibilities and the limitations of the photographic recording are discussed. Author

N70-23349*# Bell Aerosystems Co., Cleveland, Ohio.
STERILIZABLE ACCELEROMETER DEVELOPMENT PROGRAM Final Report
30 Jan. 1970 69 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951492)
(NASA-CR-109340; Rept-60007-035) Avail: CFSTI CSCL 14B

An analysis was performed of all materials used in a miniature linear force balance accelerometer to determine by analytical means and by tests the influence on the accelerometer performance of changes in the characteristics of the materials with respect to thermal expansion, electrolytically induced corrosion, stresses, strains, etc., due to the thermal sterilization procedures at 135 C. Five sterilizable versions of the accelerometer and two sets of transformerless accelerometer pickoff electronics were fabricated and tested to determine performance characteristics after sterilization. Tests included vibration, shock and ethylene oxide compatibility. In addition, five sets of sterilizable proof mass assemblies using advanced laser beam welding techniques and one sterilizable proof mass using a monolithic beryllium pendulum structure were designed and fabricated. Author

N70-23413# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
LARGE-TELESCOPE ALIGNMENT UTILIZING OPTICAL TOOLING TECHNIQUES
Glenville Rogers Dec. 1969 25 p
(Contract DAHC15-68-C-0144)
(AD-698495; Rept-1386-34-T) Avail: CFSTI CSCL 3/1

The report describes the alignment of a large astronomical telescope by the use of optical tooling techniques which are primarily based on the use of a standard-focusing aligning telescope, flat mirrors, and autocollimating procedures inside a closed dome. Because of ease of interpretation, this technique requires much less time than other alignment procedures. The only stellar observations are those required to obtain residual pointing errors, which are correctable by the indoor techniques described. The optical tooling method was successfully used to align the 60-in. Mount Haleakala astronomical telescope. On autocollimation, tilt alignment of a 60-in.-diameter mirror can be read to 3 arcsec or 0.0009 in. across the diameter. This is more precise than the capability of most mirror support systems. The techniques were also successfully applied to the two 48-in. telescopes at the Mount Haleakala Observatory. Author (TAB)

N70-23420# California Univ., Irvine. School of Engineering.
SPATIAL SIGNALS AND IMAGING SYSTEMS Final Report
Casper W. Barnes [1969] 9 p refs
(Grant NSF GK-1461)
Avail: Issuing Activity

Three studies in spatial singals and imaging systems considered (1) the relevance of information, theory to the concept of resolution in optical systems and, (2) the development of experimental techniques for measuring complex amplitude in coherent optical images as well as complex mutual coherence in a partially coherent optical field. Author

N70-23442# System Development Corp., Falls Church, Va.
STUDY OF NEAR REAL-TIME SCREENING PERFORMANCE. PART 1: SCALE, RESOLUTION, AND PRESENTATION RATE
J. Richard Lepkowski Aug. 1969 37 p
(Contract DAHC19-67-C-0050)
(AD-698455; BESRL-TRN-213) Avail: CFSTI CSCL 14/5

An experimental investigation on rapid screening performance with transmitted imagery differing in scale, resolution (quality) and rate of presentation is reported. The operational objective was to find what degrees of screening throughness and accuracy can be expected for imagery of varying quality under different conditions. Examinees participating in the study were recent enlisted graduates of a U. S. Army intelligence school. Two examinees were randomly assigned to each of 48 experimental combinations to be tested. Resolution was systematically degraded to simulate transmitted imagery using a range of radio bandwidths and a range of film processor output rates. Author (TAB)

N70-23454*# Beckman Instruments, Inc., Fullerton, Calif. Advanced Technology Operations.
STUDY OF A DESIGN MODIFICATION TO THE INFRARED MULTIDETECTOR SPECTROMETER FOR THE NIMBUS "F" EXPERIMENT Final Report
B. D. Henderson 27 Feb. 1970 154 p refs Prepared for JPL
(Contract NAS7-100; JPL-952673)
(NASA-CR-10934; FR-1042-101) Avail: CFSTI CSCL 14B

The goal of the optical analysis was to find the optimal design for a multidetector grating spectrometer. The final monochromator optical design which is presented is based heavily on the monochromator design for a proposed Mars fly-by spectrometer. The wavelength range was reduced to 3.7 micron to 6.0 micron at the preliminary design review meeting to maximize the spectral image spread. This permits the use of wider slits, resulting in a greater radiant through-put. This optical study is to develop a practical

method for each detector at the spectral image surface to receive the radiant flux from two separate spectral bands on a reciprocal time basis. The numerical difference between the central wavelengths for these two spectral bands is to be 1/2, 1-1/2, or 2-1/2, etc. spectral bandwidths. Of course, only one of these numerical difference coefficients is to be used in the final design. The detector foreoptics were designed to give a maximum spectral radiant through-put to the detector, with a minimum of stray light. Author

N70-23461# Princeton Univ., N.J. Dept. of Electrical Engineering.
MINIMIZATION OF RECONSTRUCTION ERRORS WITH COMPUTER GENERATED BINARY HOLOGRAMS
Robert A. Gabel and Bede Liu Nov. 1969 46 p refs
(Grants AF-AFOSR-1333-67; NSF GK-1439)
(AD-698766; AFOSR-69-3005TR) Avail: CFSTI CSCL 14/5

Generation of holograms by computer allows the possibility of better controlling the hologram formation process and of displaying a synthesized image in the case where the object does not exist physically. However, limitations of equipment used to plot the hologram can cause degradation of the reconstructed image. These degradations are examined for the binary Fourier transform hologram and a method is presented by which the plotting procedure may be designed so as to yield a most faithful reconstructed image. Experimental results which support the analysis are included. Author (TAB)

N70-23534# Ohio Univ., Athens. Dept. of Physics.
RADIATION IMPEDANCE OF A SMALL TRANSDUCER AT A WATER SURFACE NEAR PLANE BOUNDARIES Final Status Report, 15 Oct. 1969 - 1 Jan. 1970
F. B. Stumpf and Y. Y. Lam Jan. 1970 15 p
(Contract N00140-69-C-0103)
(AD-698308) Avail: CFSTI CSCL 20/1

The purpose of the work was to study the acoustic interaction impedance among a few small transducers at a pressure-release (air-water) surface. Experiments were continued on measurements of the normalized radiation resistance for a small hairpin magnetostrictive-stack transducer at an air-water surface radiating into the water and near plane boundaries mounted in the water. An anechoic water tank with butyl-rubber wedges is used for the measurements. Measurements of the change in the electrical motional impedance diameter with change in acoustic loading allows one to determine the radiation resistance. Author (TAB)

N70-23571# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
TESTING THE COMPARISON OF INVESTIGATION METHODS FOR HIGH-PRECISION GYROS WITH TWO DEGREES OF FREEDOM [ERPROBUNG UND VERGLEICH VON TESTVERFAHREN FUER HOCHGENAUE LAGEKREISEL]
Egmar Luebeck Sep. 1969 124 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-77) Avail: CFSTI

Various methods of investigations for two-degrees-of-freedom gyros but restricted to the determination of the systematic drift-rate components are tested and compared. The mathematical error models of the position, tumble, and servo-tests are given and proved by the measurements. The comparison considers the measuring accuracy, expenditure of time, cost of equipment and the kind of error proportions determinable by these methods. The characteristic constants at the closed gyro, such as pickoff sensitivity, scale factor, linearity of the torquer, momenta of inertia of the floated body and the viscous damping of the fluid are also determined. An appendix gives details of the dynamics of the two-degrees-of-freedom gyro, the design of the control loop and the exact alignment of the test tables with the bearing perpendicular to the earth or the pole star. Author (ESRO)

N70-23618# Research Triangle Inst., Durham, N.C.
PIEZOJUNCTION SENSOR/TRANSDUCERS
J. J. Wortman and John F. Kantak (AFOSR, Arlington, Va.) Dec. 1969 23 p refs
(Contract F44620-67-C-0048)
(AD-698777; AFOSR-69-3004TR) Avail: CFSTI CSCL 9/1

The piezojunction effect in silicon p-n junctions can provide extremely sensitive miniature sensor/transducer devices that respond to pressure, acceleration and seismic signals. The devices would provide the practical advantages of low cost, light weight, dime-size, low power requirements, and large dynamic range. Possible applications include: force transducers, pressure sensors, geophones, strain gauges, altimeters, fuel cell sensors, velocity meters, and accelerometers. Author (TAB)

N70-23645# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
LECTURES ON ELECTRON MICROSCOPY
D. Steve Bocciarelli 15 May 1969 50 p In ITALIAN; ENGLISH summary
(ISS-69/20) Avail: CFSTI

In this report, the electron microscope and its technical characteristics are described. The image formation in light microscopy is discussed in order to clarify the significance of an image obtained in the electron microscope. Author

N70-23648# Joint Publications Research Service, Washington, D.C.
COLOR-RANGE BODIES IN COLOR PHOTOGRAPHY
D. K. Balabukha et al 9 Mar. 1970 12 p refs Transl. into ENGLISH from Zh. Nauch. i Prikład. Fot. i Kinematografii (Moscow), v. 9, no. 6, 1964 p 440-447
(JPRS-50009) Avail: CFSTI

A method for constructing the color body of the color-photographic process is described, and the color bodies are constructed for six processes on multilayer film for a hydrotypic process using zonal matrix film. It is shown that the color body characteristic of the color-photographic process is based on its color-regeneration bands. This makes it possible to establish a link between the sensitometric and the colorimetric characteristics of the color-photographic process. It is concluded that to increase the precision of determining the volumes of color bodies it is necessary to improve the color-regeneration tests. F.O.S.

N70-23730*# Goerz Optical Co., Inc., Inwood, N.Y.
THE 24-INCH CASSEGRAIN-COUDE TELESCOPE Final Report
5 Dec. 1969 34 p
(Contract NAS8-20805)
(NASA-CR-102577; TR-2407) Avail: CFSTI

The design philosophy and checkout procedure for the 24-inch telescope servo system is described briefly. The description of the checkout of the polar axis system is presented in detail so that the checkout of the declination axis servo system may be completed. Author

N70-23754# California Univ., Irvine. School of Engineering.
SPATIAL SIGNALS AND IMAGING SYSTEMS
[1969] 24 p refs
(Grant NSF GK-1461)
Avail: Issuing Activity

The program described is an interdisciplinary study of spatial signals in which the concepts and techniques of modern optics, laser technology, coherence theory, statistical theory of communication, and processing of coherent and partially coherent optical images. The experimental effort has been concentrated on the crucial problem of measuring the complex amplitude distribution of coherent images. Further investigations are proposed in which the measurement technique would be extended to the problems of measuring complex mutual coherence and complex mutual spectral density in partially coherent fields. Author

N70-23771# Deutsche Forschungs- und Versuchsanstalt fuer Luft-und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
FIRST RESULTS FROM MEASUREMENTS WITH A TRANSPORTABLE RUBIDIUM CLOCK [ERSTE ERFAHRUNGEN BEI REISEN UND MESSUNGEN MIT EINER TRANSPORTABLEN RUBIDIUMUHR]
Helge Haensel Jun. 1969 29 p refs In GERMAN; ENGLISH summary
(DLR-MITT-69-18) Avail: CFSTI

The measurement of time signal propagation delays and synchronization for European satellite triangulation programs are carried out by transporting the clock to various European locations. The design of the atomic clock is described, and results and experiences are discussed, along with the characteristics of different time signal receivers. This signal receiver is widely used for the reception of HBG-transmitter signals. Author (ESRO)

N70-23780# Institut Franco-Allemand de Recherches, St. Louis (France).
SCHLIEREN PROCEDURE BY AMPLITUDE SUBTRACTION. MATHEMATICAL ANALYSIS [STRIOSCOPIE PAR SOUSTRACTION D'AMPLITUDES. ETUDE MATHEMATIQUE
L. Oudin and P. Smigielski 3 Oct. 1969 21 p refs In FRENCH
(Contract DRME-69.434)
(ISL-T-41/69) Avail: CFSTI

A mathematical analysis, using amplitude subtraction, of image quality in Schlieren photography is presented. A focusing defect is voluntarily applied in order to provide a supplementary dephasing calibration to the transverse laser group. A formula is developed to find the real intensity, and to predict the influence of the focusing defect on the image. Transl. by J.M.C.

N70-23788# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
A LASER-INTERFEROMETER SYSTEM FOR THE ABSOLUTE DETERMINATION OF THE ACCELERATION OF GRAVITY
James A. Hammond (Ph.D. Thesis—Colorodo Univ.) 26 Feb. 1970 152 p refs
(JILA-103) Avail: Issuing Activity

Precise measurements of g over extended periods of time with a drift-free instrument could possibly demonstrate long period effects of a geophysical or cosmological origin. A new instrument for the measurement of this important physical quantity has been built and its design and construction together with the results obtained with it are discussed in this thesis. The apparatus consists of a corner-cube interferometer in which one of the reflectors falls freely under the acceleration of gravity. This gives rise to fringes which may be counted providing a measurement of the distance fallen directly in terms of the wavelength of light. A stabilized He-Ne laser provides the required coherence and brightness to achieve high quality fringes over a one meter dropping distance. The stabilized wavelength of the laser has been measured with an accuracy of + or − 2 parts in 10 to the power of 8. The time base is a standard frequency oscillator which is compared with one of the 60 kHz standard radio broadcasts. The timing accuracy achieved is + or − 2 nsec. Author

N70-23826# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
LECTURES ON ELECTRON MICROSCOPY, PART 3 [APPUNTI DI MICROSCOPIA ELETTRONICA, PART 3]
D. Steve Bocciarelli 15 May 1969 71 p In ITALIAN; ENGLISH summary
(ISS-69/21) Avail: CFSTI

Imaging techniques are discussed in conventional and electronic microscopes. The magnetic lens defects are listed as chromatic aberration, spherical aberration, diffraction aberration, distortion, field curvature, and astigmatism. Other topics include: calibration, photographic processes, diffraction, and measurement of the dimensions of the objective. Transl. by F.O.S.

N70-23835# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
ELECTROMAGNETIC FLOWMETER ANALYSIS, ULTRASONIC FLOWMETER ANALYSIS, EVENTUAL APPLICATIONS OF NUCLEAR RESONANCE AND OF THE LASER [DEBITMETRIE ELECTROMAGNETIQUE, DEBIMETRIE ULTRASONIQUE, EVENTUELLES APPLICATIONS DE LA RESONANCE NUCLEAIRE ET DU LASER]
P. Peronneau Sep. 1969 40 p refs Transl. into ENGLISH from L'Onde Elec. (France), v. 46, no. 467, 1966 p 224–237 Prepared for Lincoln Lab., MIT
(AZT-69-537-FRLL) Avail: CFSTI

The fundamental physical principle, the theoretical justification, and the technological problems in the application of four methods of flowmeter analysis are given. All four exploit the direct application of a physical phenomenon to the fluid column in motion. Electromagnetic and ultrasonic flowmeter analysis are used widely in the physiology of the blood circulation. The principles of two methods of flowmeter analysis whose physiological application is completely problematical are explained. Author

N70-23844# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
SPECTROSCOPY IN THE SUBMILLIMETER WAVE LENGTH BAND [SPEKTROSKOPIA W PASMIE CZESTOSCI SUBMILINETROWYCH]
N. A. Irisova Jan. 1970 11 p refs Transl. into ENGLISH from Postepy Fiz. (Warsaw), v. 20, no. 3, 1969 p 347–352 Prepared for Lincoln Lab., MIT
(AZT-70-69-POLL) Avail: CFSTI

Recent developments in the field of millimeter and submillimeter waveband generators are discussed. Mention is made of advances in the design and construction of instruments to generate and receive frequencies in this region of the spectrum. Work with a linearly polarized monochromatic beam is described, with emphasis on the importance of proper orientation and spacing of grid wires to ensure high resolution and accuracy. Author

N70-23846# Danish Space Research Inst., Lyngby.
DESIGN AND PERFORMANCE OF AN INSTRUMENT FOR DETERMINING THE CHEMICAL COMPOSITION OF PRIMARY COSMIC RADIATION
O. Corydon-Petersen, B. Dayton, N. Lund, K. Melgaard, K. Omo et al Oct. 1969 32 p refs
Avail: CFSTI

An instrument is described which is suitable for the chemical analysis of primary cosmic radiation in the energy range above 1 GeV/nucleon. A prototype has been tested in two balloon flights and the charge and velocity of approximately 6000 nuclei of atomic number $Z > \text{or} = \text{to}$ 3 have been measured. For oxygen and for nuclei lighter than oxygen the error in determining Z (standard deviation) is approximately 0.26, and for iron nuclei it is approximately 0.32 units of charge. This resolution corresponds to a probability of 6 percent and 12 percent respectively of wrongly assigning a nucleus to one of its immediate neighbours in the atomic table. Possible improvements of the instrument are discussed. Author (ESRO)

N70-23853*# Florida Univ., Gainesville. Dept. of Metallurgical and Materials Engineering.
A STUDY OF DEFECT STRUCTURES WITH THE FIELD ION MICROSCOPE Semiannual Report, 1 Mar. –31 Aug. 1969
J. J. Hren and U. T. Son 31 Aug. 1969 28 p refs
(Grant NGR-10-005-039)
(NASA-CR-109346; SAR-7) Avail: CFSTI CSCL 14B

Progress is reported on development and testing of an atom probe field-ion microscope and quantitative measurements of atomic order in alloys of PtCo, Ni4Mo, and PtFe. Three methods to determine the long-range atomic order parameter of single

domain from field-ion images are discussed in detail. Field ion images of fully ordered and completely random states of PtCo, Ni4Mo, PtFe, and Pt3Fe were obtained. The ordered alloys show regular field ion images compatible to that of pure metals while the disordered alloys show irregular images. Author

N70-23882# Deutscher Wetterdienst, Munich (West Germany).
DEVELOPMENT AND TESTING OF A HUMIDITY SONDE BASED ON PSYCHROMETRIC PRINCIPLES [UEBER DIE ENTWICKLUNG UND ERPROBUNG EINER FEUCHTESONDE AUF PSYCHROMETRISCHER GRUNDLAGE]
Josef Grziwa Sep. 1968 47 p refs In GERMAN; ENGLISH summary
(Contract FG-IV-5/413-A-608) Avail: CFSTI

Psychrometric principles applied to radiosondes can increase the accuracy of humidity measurements in the free atmosphere. In addition, the design of the temperature and humidity components can be simplified because only resistances have to be measured. In order to test the psychrometric principles a special radiosonde was developed and a limited number of prototypes were investigated on balloon ascents and the technical details and the function of the radiosonde including the ground equipment are described and discussed. A nomogram, specially designed for aerological purposes, is used to evaluate the data. The qualification prototype for mass production is also described. Author (ESRO)

N70-23895# Naval Ordnance Lab., White Oak, Md.
THE SCANNING ELECTRON MICROSCOPE AND ITS APPLICATIONS IN FRACTURE STUDIES OF COMPOSITE MATERIALS
James V. Larsen 10 Dec. 1969 45 p refs
(AD-699140; NOLTR-69-189) Avail: CFSTI CSCL 14/2

The principles of operation of the scanning electron microscope are discussed. Detail is given concerning the formation and collection of the various types of emissions arising from electron beam bombardment of solid specimens. Applications of the SEM in fracture studies of composite materials are reviewed. Author (TAB)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N70-22676# Technische Hogeschool, Delft (Netherlands). Lab. voor Chemische Werktuigen.
FUNDAMENTAL ASPECTS OF RADIAL-FACE SEALS
J. G. Pape Dec. 1969 172 p refs
(WTHD-17) Avail: CFSTI

The results are presented of a study aimed at obtaining a reliable design for radial-face seals. The material presented includes: (1) a survey of literature on radial-face seals; (2) a description and discussion of the experimental apparatus and measuring methods used in the investigation; (3) topography of the sealing faces and of the actual operating profile of the lubricant film; (4) experimental friction and leakage data and their interpretation; (5) hydrodynamic theory and surface waviness of the sealing faces; (6) comparison of the experimental data of others with the present results; (7) unstable operation due to mutual tilt of the sealing faces; and (8) conclusions and design directives. D.L.G.

N70-22698*# General Electric Co., Santa Barbara, Calif.
AN APPLICATION OF THE REQUIREMENT vs CAPABILITY ANALYSIS TO ESTIMATING DESIGN RELIABILITY OF SOLID ROCKET MOTORS
C. R. Hermann, G. E. Ingram, and E. L. Welker Washington NASA Mar. 1970 267 p refs
(Contract NAS7-556)
(NASA-CR-1503) Avail: CFSTI CSCL 21H

The application of this methodology to an existing solid rocket motor system is described. A hypothetical example serves to explain the basic concepts and to illustrate both hand and computerized computational procedures. The solid rocket motor example demonstrates the practicality of the methodology in a realistic case, showing that the data and design relationships can be obtained and that the computational work load is not unreasonable. Author

N70-22930 Michigan State Univ., East Lansing.
ADHESION OF SMALL METAL SPHERES TO PLANE METAL SUBSTRATES
Douglas Francis St. John (Ph.D. Thesis) 1969 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-20935

In the conventional treatment of adhesion between a small solid object and a plane substrate, the object is considered to be a particle, and the adhesive force is the normal force necessary to remove it from the substrate. When this force is determined by the usual centrifuge method, it is found to be much greater than when determined by an electrostatic method or by mechanical methods other than perpendicular centrifugation. Our experiments, conducted with gold and silver spheres of 10 microns to 60 microns-diameter removed from gold, silver, and nickel plane substrates of various roughnesses, suggest that the spheres cannot be treated as particles, but must be regarded as elastic or plastic bodies of noninfinitesimal extent. The experimental results from the zenith angle centrifuge runs are interpreted on the basis of a plastic-deformation model. Dissert. Abstr.

N70-22990 IIT Research Inst., Chicago, Ill.
MOLECULAR BEAM DEPOSITION OF NICKEL CHLORIDE ON METAL SUBSTRATES
Ben Dance Holt (Ph.D. Thesis) 1969 146 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-21932

Sticking coefficients of nickel chloride on polycrystalline molybdenum, gold, and nickel have been measured by exposing the metal targets, over a temperature range of 80 to 750 K, to a molecular beam of $NiCl_2$ at 836 K. Each target, heated to a constant temperature by a radiometer-controlled electron gun, was enclosed in a liquid-nitrogen-cooled collector for the capture of molecules reevaporated from the heated surface. The total amount of $NiCl_2$ striking the target in each 90-minute exposure corresponded to > 30 monomolecular layers on the substrate. The coefficient-vs.-temperature curve differed drastically from the corresponding theoretical curve calculated on the basis of equilibrium vapor pressure and beam geometry. Whereas the theoretical coefficient changed from near unity to zero over a span of about 60 deg, the experimental coefficient did so over 265 deg. Dissert. Abstr.

N70-23101*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTS ON THE STABILITY OF WATER-LUBRICATED THREE-SECTOR HYDRODYNAMIC JOURNAL BEARINGS AT ZERO LOAD
Fredrick T. Schuller and William J. Anderson Washington Apr. 1970 21 p refs
(NASA-TN-D-5752; E-5434) Avail: CFSTI CSCL 13I

Hydrodynamic journal bearing stability tests were conducted with three-sector bearings. The bearings, consisting of three 115 deg sectors with a nominal 1.5-in. diameter, were tested in water at 80 F at speeds to 9000 rpm with zero load. Three-sector bearings with a wholly-converging-film geometry were more stable

than those with a converging-diverging film geometry. Three-sector bearings with wholly-converging-film-geometry were generally more stable and less sensitive to clearance than herringbone-grooved bearings. Author

N70-23271# Royal Radar Establishment, Malvern (England).
MACHINE POLISHING OF LASER AND OTHER SOLID STATE MATERIALS
G. W. Fynn and W. J. A. Powell Aug. 1969 53 p refs
(RRE-TN-709-Rev) Copyright. Avail: CFSTI

Preparation of optical surfaces using a modified Draper-type polishing machine is described. A technique for polishing different crystals in conjunction with silica or glass packing washers is detailed. Ancillary equipment and techniques described include low speed diamond sawing, centre and centreless grinding and crystal mounting blocks. A capacitive comparator is used to indicate parellelism errors of two seconds of arc. It is concluded that much laser optical work can be advantageously mechanised. Author (ESRO)

N70-23339# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRESSURE OF WORKING OF REFRACTORY METALS AND ALLOYS
N. I. Korneyev et al 17 Jun. 1969 358 p refs Transl. into ENGLISH of the book "Obrabotka Davleniyem Tugoplavkikh Metallov i Splavov" Moscow, Izd. Metallurgiya, 1967 p 1-268
(AD-692644; FTD-MT-24-277-68) Avail: CFSTI CSCL 11/6

The book reviews the thermomechanical conditions and elements of processing refractory metals and alloys under pressure. Methods of fabricating various semifinished products by pressure working, forging, extension, forming, rolling and drawing are discussed. TAB

N70-23358# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROBLEMS ARISING IN ELECTRON-BEAM-CONTROLLED MICROCIRCUIT MANUFACTURING PROCESSES
V. P. Derkach 13 Aug. 1969 17 p refs Transl. into ENGLISH from Russian Reports
(AD-698436; FTD-HT-23-30-69) Avail: CFSTI CSCL 13/8

The report investigates some problems which occur in the control of electron ray technological processes used in the production of microcircuitry. A brief state-of-the-art review is made, in which the limitations of manual control of microminiature production are cited, and the possibilities of applying automatic process control to three-dimensional microminiaturization are discussed. One problem is the localizing of heat at one component without excessive disturbance of the temperature equilibrium at adjacent components. The heat energy stream is given by a combination of equations. Other equations developed by the author are related to the number of impulses applied, material vaporization rates, heating and cooling rates, and other controllable parameters. The author discusses some of the basic features of a possible numerical control unit which could be used with existing production machinery. Author (TAB)

N70-23368*# Norton Research Corp., Cambridge, Mass.
SURFACE CLEANLINESS RESEARCH USING THE WORK FUNCTION TECHNIQUE Final Report
F. J. Brock [1969] 50 p refs
(Contract NAS1-5347)
(NASA-CR-66846) Avail: CFSTI CSCL 13H

The surface cleanliness of a polycrystalline tungsten sample was studied by measuring its work function. Argon ion bombardment, electron bombardment, radiation heating, and controlled oxidation (vacuum) were evaluated with respect to their effectiveness in initial cleaning as determined by surface potential measurements. Work function measurement techniques were evaluated with respect to determining their usefulness in detecting surface contamination, by controlled oxygen adsorption on the sample surface. It was found that a surface oxygen relative coverage theta < 1/2% could be observed. For surface oxygen relative coverages theta < or = to 2 it was found that the surface could be cleaned by argon ion bombardment doses (the approximate equivalent of 10 monolayers of argon) for ion energies within the range (250 < or = to E < or = to 500) eV. It was also found for low coverage, that surface oxygen could be completely removed by electron bombardment for 30 seconds at an electron current density of J = 0.01 A/sq cm at surface temperatures T sub s approximately 1200 K but that radiation and resistance heating alone at the same temperature did not completely remove the adsorbed oxygen. Author

N70-23376*# Rocketdyne, Canoga Park, Calif.
FABRICATION TECHNIQUES FOR SHROUDED TITANIUM IMPELLER Final Report, 29 Jun. 1967 - 30 Sep. 1969
James E. Wolf 10 Dec. 1969 109 p
(Contract NAS8-20761)
(NASA-CR-102589; R-8061) Avail: CFSTI CSCL 13H

This report describes the development of diffusion bonding technique for fabrication of shrouded titanium centrifugal impellers. Trial samples were used to develop the optimum procedure and two shrouded, titanium impellers were successfully diffusion-bonded and finish-machined. Both of the impellers were also successfully spin-tested to demonstrate the feasibility of the diffusion bonding process for attaching shrouds on centrifugal impellers. Author

N70-23483# Electroweave, Inc., Rockland, Mass.
ANCIENT ART TURNS MODERN: THE WOVEN CABLE Technical Report
Alan P. Mandel and Kenneth Sennett Dec. 1969 21 p refs Presented at the 18th Intern. Wire and Cable Symp., Atlantic City, 3-5 Dec. 1969
(AD-698603; TR-5730) Avail: CFSTI CSCL 9/1

Processes and materials used to manufacture woven electronic cables are fully described. Presented are the trade-offs available to the packaging design engineer which allow him to optimize an electronic cable to his specific system requirements, and yet produce an economical part which is highly reliable. Specific designs are discussed and illustrated in the paper. Author (TAB)

N70-23535# Union Carbide Corp., White Plains, N.Y.
EXTRUSION OF CELLULAR POLYETHYLENE FOR CATV COAXIAL CABLES
B. H. Maddock 4 Dec. 1969 27 p refs Presented at 18th Intern. Wire and Cable Symp., Atlantic City, 4 Dec. 1969
(AD-698718) Avail: CFSTI CSCL 11/9

The structural return loss requirements for CATV cable dictate that any periodic change in extruder delivery rate or screw speed cannot exceed a magnitude of 0.05-0.09 degrees depending upon cable size. This is beyond the capability of drive motor speed regulation systems normally employed. Use of synchronous motors with variable frequency speed control should eliminate this problem. If the screw speed pulse is not eliminated, SRL spikes can be forced out of the useable frequency range (above 300 MHz) by matching the extruder delivery rate to the cable size requirement in such a way that the line speed/screw speed ratio does not exceed 1.33. This means that the extruder should not deliver more than 1.6, 2.5 and 5.5 lb./hr./RPM, respectively, for the .360 in., .450 in. and .680 in. OD cables. It says that SRL problems would exist with one or more of the cable types made with any of the larger size extruders. Screw design is not critical as long as screw cooling is employed and the cooling conditions optimized. Author (TAB)

N70-23808# California Univ., Livermore. Lawrence Radiation Lab.
CONTROL OF SPIKING IN PARTIAL PENETRATION ELECTRON-BEAM WELDS
R. E. Armstrong 8 Aug. 1969 28 p refs Sponsored by AEC
(UCRL-71894) Avail: CFSTI

The effects of machine parameters—accelerating voltage, heat

input, travel speed, beam focus position, and beam oscillation—on the amount of spiking in deep partial-penetration electron-beam welds in uranium was investigated. When the electron-beam is operating in the hole-drilling mode, any parameter change that reduces the power density of the beam in the hole reduces spiking and gives a smoother root, but it also reduces the depth of penetration. When the power density of the beam is increased to regain the depth of penetration, the amount and length of spiking is increased. The conclusion is that spiking is not a function of individual machine parameters but is inherent in a high-depth-to-width-ratio electron-beam weld. Author (NSA)

N70-23778 National Lending Library for Science and Technology, Boston Spa (England).
A NEW APPARATUS TO INVESTIGATE LUBRICATION OF METALLIC FRICTION SURFACES AT HIGH LOAD OR HIGH TEMPERATURE
W. Baist 22 Oct. 1969 23 p refs Transl. into ENGLISH from Erdoel Kohle-Erdas-Petrochemie, (Hamburg), v. 22, no. 1, Jan. 1969 p 24–29
(NLL-Trans-1156-(9022.9) Avail: Natl. Lending Library, Boston Spa, Eng.: .2 NLL photocopy coupons

Owing to the contradictory data from lubricant testing machines, the opinion is growing that reliable lubricant tests can be carried out only in full-scale engines. This, however, ignores the fact that the complex problem, which is dependent upon many factors, will hence become even more complex. After it was not possible, in more than 1,000 full-scale engine tests, to find any system underlying the causes of wear, the opposite way back to the testing apparatus was pursued. The guiding principle here was to disentangle, to a large extent, the complexity of the problem, and to measure what was in any way possible in order to be informed at all times concerning the conditions in the frictional surfaces and the external conditions. The result of this development work is the friction-wear apparatus described below. Author

N70-23785 National Lending Library for Science and Technology, Boston Spa (England).
ELECTROLYTE REQUIREMENTS FOR THE DIMENSIONAL ELECTROCHEMICAL MACHINING OF METALS [TREBOVANIYA K ELEKTROLITAM DLYA RAZMERNOI ELEKTROKHIMICHESKOI OBRABOTKI METALLOV]
Yu. S. Volkov et al Dec. 1969 9 p refs Transl. into ENGLISH from Fiz. i Khim. Obrabotki Materialov (USSR), v. 5, 1968 p 63–67
(NLL-RTS-5221) Avail: Natl. Lending Library, Boston Spa, Engl.: 12s 6d or 2 NLL photocopy coupons

Discussed are the requirements which must be met by the electrolyte if the machining process on a metal is to proceed stably and at a high stock removal rate. A procedure is outlined for the analytical selection of electrolytes according to the properties of the workpiece metal. Author

N70-23861# Deutscher Wetterdienst, Munich (West Germany).
ANEROID CAPSULES FOR RADIOSONDES [UEBER ANEROID-DOSEN FUER RADIOSONDEN]
Camillo Fink Aug. 1968 71 p in GERMAN; ENGLISH summary
(Contract FG-IV-5/413-A-806)
Avail: CFSTI

This report concerns different German and American aneroid capsules used in radiosondes. Usually, studies on aneroids deal with calibration stability, hysteresis and temperature coefficients. However, in this study additional characteristics were defined to meet increased accuracy requirements and to improve the production of aneroid capsules. The Instrumentenamt München of the Deutscher Wetterdienst has developed a precise radiosonde for pressure only. This reference sonde was used as a test apparatus for investigating capsules in the laboratory and the relation between capsule displacement and pressure was precisely tested because the capsule operated free of load. The investigation produced detailed data on the properties of aneroids from which it follows that aneroid manufacture must be carefully controlled to obtain equal characteristics. Aneroids working over the aerological range between 1000 and 10 mb can be accurate to about + or − 20.1 mb if they are free of additional load. However, even with the best aneroids produced in series, the individual capsules showed a remarkable variation of the characteristics. Requirements for manufacturing improved aneroid capsules are discussed. Author (ESRO)

N70-23887# Army Materials and Mechanics Research Center, Watertown, Mass.
SOLIDIFICATION AND SEGREGATION IN CU-NI AND CB-TI WELDMENTS
Warren C. Malatesta Mar. 1969 26 p
(Contract DA-1-T-062105-A-328)
(AD-699347; AMMRC-TR-69-04) Avail: CFSTI CSCL 13/5

A study was made of the influences that base metal chemistry, microstructure, and input weld energies have upon the solidification mode of binary alloy weld metals. For this study weld metals were produced in as-cast Cu-Ni and Cb-Ti alloys, using high and low concentrated energy input welding sources. Metallographic studies of Cu-Ni solidification structures show that a single fusion zone dendrite arm supports epitaxial growth of many weld metal dendrites. Interdendritic melting of cast base metal structure, responsible for the development of fusion zone areas in weldments, is directly related to the melting point of the solvent element and dependent upon the concentrated energy input used for welding fabrication. Microprobe analysis indicates that interdendritic phases of Cu-Ni solidification structures are more highly segregated than dendritic phases, and that fusion zone areas are overall the most critical regions for the development of microsegregation. Metallographic study of Cb-Ti solidification structures shows that an epitaxial relationship exists on a grain and subgrain size level between the fusion zone and weld metal growth structures. Microprobe data show that the level of segregation developed in Cb-Ti weldments is a function of the temperature range between the liquidus and solidus points of the particular alloy and that segregation increases as the width of the temperature range increases. Author (TAB)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N70-22598*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A GUIDE TO THE LITERATURE ON CARBON DIOXIDE LASERS, 1 JULY 1968–30 JUNE 1969
Steven C. Flagiello, John H. McElroy, John B. McDay, and Harold E. Walker Feb. 1970 65 p refs
(NASA-TM-X-63851; X-524-70-45) Avail: CFSTI CSCL 20E

The results of a literature search are presented in a chronological listing. Each item contains three sections: a standard bibliographical listing, an abstract of the paper or article, and a comprehensive listing of keywords or phrases extracted from the publication. This listing is followed by an alphabetical listing of the authors. The third listing gives, in alphabetical order, the extracted keywords and phrases referenced to the articles by the chronological reference number. Author

N70-22647# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
EXPERIMENTAL OBSERVATIONS OF ROCK FAILURE DUE TO LASER RADIATION Research Report
G. Ferra, C. R. Nelson, and F. Moavenzadeh Apr. 1969 130 p refs
(Contract C-85-65)
(PB-18274; R69-16) Avail: CFSTI CSCL 13M

Hard rock tunnelling is an expensive process due to the

fact that tunnelling machines must be extremely rugged and powerful to overcome the high strength of intact hard rock. There has been a considerable amount of interest in assisting the progress of hard rock tunnelling machines by developing techniques to weaken the rock before it is mechanically broken. The report reviews the present state of knowledge about the interaction of laser radiation with solid materials such as rocks. It also presents experimental techniques used to cause various modes of failure in rock specimens by laser irradiation. The thermal and mechanical responses of laser irradiated specimens were observed and these phenomena were compared with the analytical data for the temperature and stress distributions in such specimens. Author (USGRDR)

N70-22697# Defence Research Board, Ottawa (Ontario).
LASER APPLICATIONS IN BALLISTICS RESEARCH [QUELQUES APPLICATIONS DU LASER DANS LA RECHERCHE BALISTIQUE]
K. Vollrath Dec. 1969 36 p refs Transl. into FRENCH of Inst. Franco-Allemand de Rech. de Saint-Louis Note Tech. ISL-T-31-66 (T-126-G; ISL-T-31-66) Avail: CFSTI

Current uses of the laser are discussed emphasizing laser types in ultrarapid photography, holography, interferometric measurement of rapidly moving objects, and as a focused irradiant beam. Applications of the laser in aeroballistic tunnels, in cinematography, and in uniformly distributed reflected light photography are assessed. Projected applications and a bibliography are also presented. Transl. by M.H.E.

N70-22805 Ohio State Univ., Columbus.
POLARIZATION EFFECTS IN A HELIUM-NEON RING LASER
James Russell Bupp (Ph.D. Thesis) 1968 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-4853

The method of time dependent perturbation theory is used to find a solution of the time dependent Schrodinger equation for monochromatic radiation interacting with an atom in zero magnetic field. The solution is valid only for atoms which have degenerate atomic levels. For a two level problem, the amplitude of the macroscopic electric polarization is modulated at a single frequency which depends upon the strength of the interaction. For a multilevel problem, the amplitude of the macroscopic electric polarization is modulated at more than one frequency and the concept of 180 deg pulses is no longer applicable. The theory of Heer and Graft is used to discuss the polarization of a single longitudinal mode in a 1.15 micron He-Ne ring laser. Application of this theory leads to four nonlinear amplitude and four nonlinear phase equations. At line center, the phase equations show that the clockwise and counterclockwise traveling waves lock to orthogonal states of linear polarization. An identical conclusion is reached for an arbitrary frequency of oscillation if the external magnetic field is assumed to be zero and the cw and ccw traveling waves are assumed to be linearly polarized. Using the method of phase trajectories, the amplitude equations are found to be stable for the above assumptions. Dissert. Abstr.

N70-23424# United Aircraft Corp., East Hartford, Conn. Research Labs.
PICOSECOND LASER PULSES Quarterly Technical Report, 1 Sep. -30 Nov. 1969
Anthony J. De Maria, William H. Glenn, Michael E. Mack, and E. Brain Treacy 29 Dec. 1969 26 p refs
(Contract N00014-66-C-0344; ARPA Order 306)
(AD-698557; UARL-H-920479-19) Avail: CFSTI CSCL 20/5

The report describes experimental investigations of stimulated rotational and vibrational Raman scattering in gases, analytical investigations of nonlinear propagation effects in Kerr active liquids and a discussion of the generation of Cerenkov radiation by light pulses. Author (TAB)

N70-23718# Naval Research Lab., Washington, D.C.
ELECTRICAL NOISE IN GaAs DIODE LASERS Final Report, Oct. 1968 -Jan. 1969
T. Robert Royt 30 Oct. 1969 66 p refs
(AD-698281; NRL-6980) Avail: CFSTI CSCL 20/5

Measurements were made of the current fluctuations at 30 MHz generated in a GaAs diode during luminescent and lasing operation. It was found that thermal noise predominates over other effects. Calculations indicate that this dominance is due to the small junction resistances which occur at helium temperatures. In addition, the line loss in the transmission system was found to limit the measurement system sensitivity. Author (TAB)

N70-23739# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
LASER RANGING TO THE SATELLITE GEOS A WITH THE MOUNT HALEAKALA OBSERVATORY LASER RANGING SYSTEM
Paul D. Mc Cormick and Williard L. Myers Dec. 1970 35 p
(Contract DAHC-15-68-C-0144)
(AD-698494; Rept-1386-32-T) Avail: CFSTI CSCL 17/8

The report describes a successful laser ranging experiment which was conducted on the retroreflector satellite GEOS A on 23 May 1969 at the Mount Haleakala Observatory, Maui, Hawaii. A total of 99 returns were obtained out of 113 laser firings during the sunlit portion of the satellites pass. The returns were obtained from ranges of 2326 to 2937 km. The observed ranges are compared to predictions made by the Smithsonian Astrophysical Observatory, and it is found that the agreement is excellent. Acquisition and tracking techniques used during the ranging experiment are discussed. Photographs of the satellite and of an outgoing laser pulse (as seen on a television monitor) are presented. A brief description of the laser system and relevant Observatory support systems is also included along with some information on retroreflector satellites. Author (TAB)

N70-23747# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
CONSTRUCTION OF GaAs INJECTION LASERS FOR CW OPERATION AT HIGH TEMPERATURES [AUFBAU VON Ga As-INJECTIONSLASERN FUER DAUERSTRICHBETRIEB BEI HOHEN TEMPERATUREN]
H. Knapp et al Dec. 1969 15 p refs Transl. into ENGLISH from Z. Angew. Phys. (Berlin), v. 25, no. 5, 1968 p 277 -281
Prepared for Lincoln Lab., MIT
(AZT-69-644-GELL) Avail: CFSTI

For the application of GaAs injection lasers in optical radar and optical communication systems continuous wave operation is desired or even needed. One way to achieve this is to improve the gain and the losses of the lasers. Another way is to improve the heat dissipation in order to prevent heating of the diodes and thus a further increase of the threshold currents. In this paper it is shown that continuous wave operation of GaAs injection lasers at room temperature should be possible with threshold current densities available today if suitable designs and heat-sink materials are employed. Author

N70-23831# Fraunhofer Institut, Freiburg (West Germany).
POSSIBLE PRODUCTION OF A LASER FLASH-LIGHT FOR HIGH-SPEED PHOTOGRAPHY [MOEGLICHKEITEN ZUR ERZEUGUNG VON LASER-LICHTBLITZSERIEN FUER DIE KURZZEITFOTOGRAFIE]
A. Alfs 30 Jun. 1969 41 p refs In GERMAN
(Rept-7/69) Avail: CFSTI

After surveying laser produced light pulse series, two methods for generating regular flash series with a ruby laser are described: (a) without external intervention, using only an appropriate resonator or by immersion of the active medium, with self Q-switching saturable absorbers e.g. colored glass, organic dye solutions in the resonator. The laser material itself can be used for this purpose, if

it has the appropriate geometrical form ; (b) by actively regulating the losses in the resonator, i.e. by internal modulation by means of Q-switching, or by external light modulation, in which case separate light pulses are selected out of a continuous or irregular pulsating laster light beam. The pulse series produced by these methods range in pulse frequency from single pulses to the lower megahertz range, and in pulse duration from one microsecond to a few nanoseconds. With the aid of mode-locking and mode competition it should be possible to reach frequencies of about one gigahertz and pulse durations of a few picoseconds. ESRO

N70-23869# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

LASER-BEAM IN THE ATMOSPHERE [LUCH LAZERA V ATMOSFERE]

V. Ye. Zuyev Dec. 1969 11 p Transl. into ENGLISH from Nauka Tekhn. (Riga), no. 4, 1967 p 22–24 Prepared for Lincoln Lab., MIT

(AZT-70-67-RULL) Avail: CFSTI

Properties of laser beams are reviewed and the possibility of applying lasers in connection with the propagation of emission energy in the atmosphere is considered. The advantages of lasers for these purposes include high monochromaticity, directivity, and high density of emissions permitting the transmission of information between space objects at very great distances. Factors causing the weakening of laser emissions in the atmosphere such as energy absorption by gas molecules, and both molecular and turbulent scattering by atmospheric particles are discussed. Evidence in support of the atmosphere as a complex barrier in a laser beam path is established from the point of view of beam energetics only. In these terms, it is necessary to have generators whose emissions fall in the intervals between the weak absorption lines located far from the strong lines. M.H.E.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N70-22510# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE PRODUCTION OF CASTINGS FROM ALUMINUM ALLOYS

M. N. Galkin 12 Aug. 1969 23 p Transl. into ENGLISH from Aviatsionnyi Tekhnol. Inst. (Moscow), no. 67, 1966 p 122–134

(AD-698540; FTD-MT-24-184-69) Avail: CFSTI CSCL 13/8

In the solution of solidification problems the difference between the volume of solidified metal and the volume of the crust formed on the channel walls must be taken into account. This difference is attributed to the mech. interaction between the solid and liquid phases in which several solidified metal particles are washed down from the cooled surface. Quantitative appraisal of the difference can be established by the wash-down coefficient K which characterizes the relative rate of the crust growth in the moving metal stream. The coefficient is dimensionless, its values being 0-1. The relation between K and Re, Bi, and N (the Reynolds, Biot, and phase-transition nos., resp.) was established exptl. by using flows of Zn, Pb, Al and eutectic alloys of Zn-Pb and Al-Cu. Two exptl. methods are outlined to determine K. In the laminar flow regime, the wash-down of the solid phase from the cooled surface is insignificant. In the turbulent regime, the wash-down increases exponentially with Re. With an increase in the ratio N, Bi, K decreases rapidly towards 0. At the crystallization temperature, the flow causes a wash-down of the crust which is 5-30 percent of the total metal solidified. TAB

N70-22519 National Lending Library for Science and Technology, Boston Spa (England).

ANISOTROPY OF THE INFLUENCE OF SURFACE NICKEL FILMS ON THE MAGNETIC PROPERTIES OF AN Fe-Si ALLOY

E. A. Prokopchenko et al 22 Oct. 1969 3 p refs Transl. in ENGLISH from Fiz. Metal. Metalloved. (USSR), v. 26, no. 4, 1969 p 745–747 In ENGLISH and RUSSIAN

(NLL-Trans-746-250-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The influence of surface nickel films on the magnetostriction, coercive force and remanent induction of an Fe-Si alloy is studied in cold rolled transformer steel. The specimens were cut in the direction of rolling, at right angles, and at an angle of 55 deg to the direction of rolling. It was assumed that the following axes lie in the sheet plane: [100] in the direction to rolling, [110] at right angles to the direction of rolling, and [111] at an angle of 55 deg to the direction of rolling. The magnetostriction for each of these specimens is given. The results indicate that the application of nickel films to the specimen surface decreases the magnetostriction and, produces an increase in coercive force, and remanent induction. F.O.S.

N70-22570 National Lending Library for Science and Technology, Boston Spa (England).

METHOD OF ASSESSING THE CRITICAL THICKNESS IN THE TRANSITION OF STEEL TO BRITTLE FRACTURE

Yu. A. Denisov et al 22 Oct. 1969 3 p refs Transl. into ENGLISH from Zavodsk. Lab. (USSR), v. 35, no. 5, 1969 p 621–622

(NLL-RISLEY-Trans-1781-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The effect of specimen thickness on brittle fracturing was determined using specimens with triangular cross sections. On deflection of the specimen, a crack is propagated from the apex to the base, and where the thickness reaches the critical value the ductile fracture changes to brittle fracture. It is concluded that the use of a single nonuniform specimen in place of a series of rectangular specimens facilitates the assessment of the critical thickness. N.E.N.

N70-22577 National Lending Library for Science and Technology, Boston Spa (England).

DEPOSITION OF SOME METALS AND ALLOYS FROM COMPLEX POLYLIGAND ELECTROLYTES

F. K. Andryushchenko 22 Oct. 1969 5 p refs Transl. into ENGLISH from Zashch. Metallov (Russian)

(NLL-Trans-746-297-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Theoretical considerations underlying the choice of components in the metal and alloy deposition are discussed, and the role of individual ligands and their mutual effect on the kinetics of electrode processes are examined. Data are presented on the cathodic processes in the deposition of Ag, Ni, Fe, and Ni-Fe alloys from complex polyligand electrolytes. Author

N70-22585# Cincinnati Univ., Ohio. Materials Science Program

THE THERMAL CONDUCTIVITY AND TOTAL EMITTANCE OF TUNGSTEN AT 1800 TO 2800 K Technical Report, 1 Sep. 1967–30 Jun. 1968

C. K. Jun, Salman Ebrahim, and M. Hoch Oct. 1969 65 p refs

(Contract F33615-67-C-1445)

(AD-698357; AFML-TR-69-275) Avail: CFSTI CSCL 11/6

The thermal conductivities and total emittances of six tungsten samples prepared by different manufacturers using either arc-cast methods or powder metallurgy techniques were measured in the temperature range 2000 - 2800K. The thermal conductivity of commercially prepared arc-cast samples is slightly higher than the thermal conductivity of commercially prepared powder metallurgy samples. In both cases the thermal conductivity is independent of

temperature. The total emittance at 2500K for the powder metallurgy samples is 0.25 and 0.29 for the arc-cast samples. The specially prepared materials have thermal conductivities and emittances which are different from the conductivity and emittance of commercially available materials. Author (TAB)

N70-22607# Illinois Univ., Urbana. Materials Research Lab.
CRYSTAL GEOMETRY AND MECHANISMS OF PHASE TRANSFORMATIONS IN CRYSTALLINE SOLIDS
David S. Lieberman 1968 132 p refs Presented at the Am. Soc. of Metals Seminar on Phase Transformations, Detroit, 12-13 Oct. 1968
(Contract AT(11-1)-1198)
(PB-187956; COO-1198-609) Avail: CFSTI CSCL 20B

Contents: The development of the crystallographic theory of martensitic transformations: Historical perspective; The transformation in near equiatomic AuCd; The model of the transformation and the physics of the theory; Methods of calculation; Comparison with experiment; Application to other systems and classification of transformations; On the dilatation or ignorance factor, physical property changes, and the mechanism of transformation; The importance of shuffles in martensitic transformations. USGRDR

N70-22608# Bureau of Mines, Washington, D.C.
REFINING ZINC-BASE DIE-CAST SCRAP USING LOW-COST FLUXES
D. Montagna and J. A. Ruppert Oct. 1969 14 p refs
(PB-187721; BM-RI-7315) Avail: CFSTI CSCL 11F

Large quantities of zinc-base die-cast scrap containing 3 to 4 percent aluminum are presently refined by mixing with other secondary zinc products such as galvanizer dross and distilling in a retort. Alternate aluminum removal processes utilizing low-cost fluxes were investigated. Basing the investigation on the metallurgical principle that a reactive impurity can be removed from a less reactive matrix metal by melting under a flux consisting of a salt or oxide of a metal less reactive than the impurity, three separate flux mixtures were studied. In the first flux system, $FeCl_3 + NaCl$ (the active component is underlined), part of the aluminum is eliminated by the formation of volatile aluminum chloride and the rest by the creation of a high melting point iron-aluminum intermetallic compound that can be separated from the remaining molten zinc by filtration. Author (USGRDR)

N70-22612 Stanford Univ., Calif.
GENERATION OF CHEMICAL POTENTIALS BY ANALYSIS OF PHASE DIAGRAMS
Ronald Hiskes (Ph.D. Thesis) 1968 264 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 69-8196

A method is presented for the determination of the thermodynamic properties of alloys without recourse to either tedious experimentation or a theoretical model, requiring only the phase equilibria data for the system plus the melting temperatures, entropies of fusion, and specific heats of the pure components. The method involves a series expansion of a function of the chemical potential in both temperature and composition. A wide variety of different types of binary phase diagrams are analyzed, including Au-Ag, Bi-Sb, Ge-Si, Au-Pt, Ag-Si, Ag-Cu, Cd-Zn, Pb-Sn, Al-Zn, and Cu-Zn. Excellent agreement with experimental thermodynamic data is found for all of these systems. Dissert. Abstr.

N70-22641 Syracuse Univ., N.Y.
THE LIQUID STATE DENSITIES OF METALS, ALLOYS AND INTERMETALLIC COMPOUNDS
Roger John Grant (Ph.D. Thesis) 1968 228 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 69-7740

Density isotherms were determined for seven binary metallic systems, Mg-Tl, Mg-Pb, Tl-Te, Sb-Te, Sn-Te, As-Te and Zn-Sb. The composition range studied was generally close to the stoichiometries corresponding to known solid state compounds, in order to investigate possible changes in structure within the melt as the composition was varied. Inflections in the isotherms were observed for the systems Mg-Tl, Mg-Pb and Tl-Te. An automatic recording balance was used to accurately determine the immiscibility boundary and the melting point of the compound Tl5 Te3 for the Tl-Te system. The same method was employed to establish the liquidus boundary for the As-Te system up to 42 At % As, where the immiscibility boundary begins. The variation of density with temperature was determined for the pure metals Mg, Pb, Sn, Bi, Te, Sb, and Tl. For all metals except Te, density was a linear function of temperature over the temperature range studied. Dissert. Abstr.

N70-22653 Cornell Univ., Ithaca, N.Y.
HYDROSTATIC PRESSURE DEPENDENCE OF CREEP IN ALUMINUM
Paul Gerard Mc Cormick (Ph.D. Thesis) 1968 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-5767

Since the activation volume for a vacancy diffusion mechanism is a unique quantity, independent of the vacancy concentration, measurements of the activation volume for creep in the temperature range below 0.6 indicates whether or not vacancy supersaturations occur. The temperature and pressure dependence of the activation volume for creep in high-purity, polycrystalline aluminum was measured in the temperature range 0.2 to 0.6. The activation volume decreases sharply at 0.6, indicating that the rate controlling mechanism changes before significant vacancy supersaturations are built up in the lattice. Two distinct plateaus were observed in the activation volume-temperature curve below 0.6 which are associated with independent, rate controlling processes in the respective temperature regions in which they occur. Several models for the plateaus are discussed, and using an approximate pipe diffusion model reasonable estimates of the source-sink spacing are obtained. Dissert. Abstr.

N70-22656 Northwestern Univ., Evanston, Ill.
A PULSE HEATING STUDY OF VAPOR QUENCHED COPPER SILVER ALLOYS
Ernest Lee Huston (Ph.D. Thesis) 1968 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-6944

A pulse heating technique was developed to facilitate the measurement of certain thermodynamic properties of thin metallic specimens. It permits the simultaneous measurement of the power input and resistance ratio over the entire temperature range from ambient to the melting point at heating rates from 1 to 10 million deg C/sec. Measurements were performed on rolled Ag and Al foils. Metastable solid solutions of copper-silver alloys were prepared by vapor quenching. The resistivity of these alloys was a smooth approximately parabolic function of composition. The observed melting temperature of the vapor quenched alloys was less than the eutectic temperature (779 C) for a wide range of compositions. The minimum melting temperature was 600 C at 35 at. % Ag. From these values the Gibbs free energy of mixing for the metastable solid solution was calculated. Dissert. Abstr.

N70-22678 George Washington Univ., Washington, D.C.
A UNIFIED THEORY OF INCREMENTAL PLASTIC DEFORMATION BASED ON THE DISTRIBUTION OF DISLOCATIONS, WITH APPLICATIONS TO ALUMINUM
John Henry Kelly (Ph.D. Thesis) 1968 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-5747

A mathematically consistent theory of incremental deformations, based on a theory of dislocations utilizing non-Riemannian geometry, is presented. The theory includes two fundamental geometrical constructs: the coefficient of connection

and the curvature tensor. An intuitive meaning is proposed for each term in the expression for these constructs. These physical interpretations lead to a qualitative prediction of the stress-strain curve for a single crystal of a face-centered cubic metal. In addition, they provide an original explanation of the Portevin-Lechatelier effect in polycrystalline specimens. The basic theory of incremental deformations is defined on two levels: a microscopic one in terms of the lattice vectors and a macroscopic one in terms of the coordinates used in taking physical measurements. A technique is suggested for correlating these two descriptions. Dissert. Abstr.

N70-22738# California Inst. of Tech., Pasadena. Lab. of Engineering Materials.
METASTABLE PHASES IN LIQUID QUENCHED ALLOYS OF CR, MN, FE, CO AND NI WITH SB Research and Development Report No. 69
W. M. Keck and J. D. Speight Jul. 1969 12 p refs
(Contract AT(04-3)-221)
(PB-87719; CALT-221-71) Avail: CFSTI CSCL 11F

The occurrence of a simple cubic phase in liquid quenched Ni-rich, Ni-Sb alloys suggested that it might be of interest to investigate the constitution of rapidly quenched alloys of Sb with other transition metals. In the present work alloys in the Cr-Sb, Mn-Sb, Fe-Sb, Co-Sb and Ni-Sb systems were investigated. The alloys containing Cr, Fe and Co were of particular interest as the Sb-rich portion of the equilibrium diagrams of these systems is very similar to that of Ni-Sb. Author (USGRDR)

N70-22769# Washington Univ., Seattle. Coll. of Engineering.
A STUDY OF PHASE TRANSFORMATIONS AND SUPERCONDUCTIVITY Progress Report
Douglas H. Polonis 15 Oct. 1969 26 p refs
(Contract AT(45-1)-1375)
(RLO-1375-18; PR-10) Avail: CFSTI

Electron microscopy studies of the martensite transformation in titanium alloys are described. The structure of the martensitic phases that occur in Ti-Cu alloys containing up to 8 wt % copper was investigated using transmission electron microscopy. It was determined that a massive martensite phase forms in alloys containing less than 4% copper; whereas, an acicular martensite occurs in the higher alloys. A model was developed to account for the transition from the massive to the acicular martensite morphology. Electron microscopy techniques were employed to study the decomposition of the martensitic and supersaturated alpha phases. The results obtained have pointed clearly to the usefulness of superconducting transition temperature measurements in conjunction with electron microscopy techniques for the study of phase transformation phenomena in titanium and zirconium base alloys. The various stages of the nucleation and growth processes were monitored by examining the details of the specimen inductance change during the transition from the normal to the superconducting state. Author (NSA)

N70-22867*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE SIMULATORS AND FACILITY ENGINEERING
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 174-181 ref (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 11F

Performance tests on solid metallic mercury at minus 95 degree F established the following: (1) liquid mercury adhers poorly to solids whereas solid mercury adhered resolutely to the container it had been frozen in; (2) creep is large and measurable when compressive loads of 97.4 psi and 37.5 psi are applied to frozen mercury; and (3) application of 42.6 psi tensile stress to a frozen mercury test specimen induced creep and specimen rupture. G.G.

N70-22886 Purdue Univ., Lafayette, Ind.
DISLOCATION ARRANGEMENTS RESULTING FROM THE DIFFUSION OF ZINC INTO COPPER
Paul Sheridan Ayres 1968 210 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-7417

Transmission electron microscopy of thin foils and etch pitting techniques, employing both optical microscopy and electron microscopy of replicas, were used to examine the substructural changes that occurred in copper single crystal specimens as a result of the introduction into each crystal of a zinc concentration gradient that was produced by a one hundred hour, vapor transport diffusion anneal at 780 C with alpha brass source material. Comparison of the experimentally determined dislocation densities with the dislocation density predicted by a theoretical model based on the concept that dislocations are produced by the lattice parameter gradients in the diffusion zone, indicates that these gradients were primarily responsible for the dislocations observed in this research, although vacancy source requirements also played a role in determining the ultimate substructure. Dissert. Abstr.

N70-22897# Thermo Electron Corp., Waltham, Mass.
TOPICAL REPORT: STUDY OF VAPOR-DEPOSITED TUNGSTEN AND TUNGSTEN-RHENIUM ALLOYS FOR USE AS THERMIONIC EMITTERS
L. van Someren 30 Jun. 1969 58 p refs
(Contract AT(30-1)-3874)
(TEE-3874-1; TE-4086-166-69) Avail: CFSTI

The spatial distribution of a single crystal-plane in a polycrystalline specimen can be explored by X-rays, and the resulting pole figure can be useful either in ranking members of a set of specimens according to their degree of preferred orientation, or in studying the dependence of the microstructure on mechanical and thermal treatment of the specimen. Vapor deposited and wrought W specimens have been examined. It is found that grinding produces a randomly oriented surface; mild heat treatments typically used in emitter preparation recrystallize this very little, so that the highly oriented emitters often used may in fact have a nearly randomly oriented surface. The heat treatment necessary to recrystallize the random layer and regenerate the underlying orientation is indicated. It is found that the removal of two mils of tungsten by electropolishing is sufficient to eliminate the random layer introduced by grinding and to expose the substrate orientation. Author (NSA)

N70-22980 Lehigh Univ., Bethlehem, Pa.
GROWTH OF SILICON-GERMANIUM EPITAXIAL SOLID SOLUTIONS AND THE EFFECT OF THE ALLOY COMPOSITION ON THE DIFFUSION CONSTANTS OF BORON AND PHOSPHORUS
Kenneth Earl Benson (Ph.D. Thesis) 1968 146 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-7324

Alloys containing up to 52 atom percent germanium were shown to be single crystal films as evidenced by Laue X-ray back reflection, pin hole back reflection and glancing angle electron diffraction techniques. Electron microprobe analysis showed that the composition of the films was uniform to + or - 2 per cent relative to the amount present. Compositions of the alloys for different deposition runs were maintained within about 10 percent of the nominal composition. The composition of the alloy films was shown to be within a few percent of that which would be expected from calculations based on equal reduction rates of GeCl4 and SiCl4. The striated surface topography of the epitaxial alloy films was shown to be the result of small slip steps. This finding is contradictory to previous investigators who assumed the striations were caused by solute inhomogeneities. The slip steps, which occur at the early stages of deposition, are caused by the lattice mismatch between the alloy and the silicon substrate. Boron and phosphorus diffusion experiments on the epitaxial films have revealed that at germanium concentrations greater than about 20 atom percent, the alloy starts to have diffusion attributes similar to germanium. Dissert. Abstr.

N70-23001 Northwestern Univ., Evanston, Ill.
INTERDIFFUSION IN COPPER-PALLADIUM: A VERIFICATION OF A NEW DIFFUSION EQUATION
Elliott Malcolm Philofsky (Ph.D. Thesis) 1968 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-6977

Interdiffusion coefficients have been measured for Cu-Pd alloys using multilayer specimens prepared by the simultaneous evaporation of the two components. The composition was sinusoidally modulated in the specimens with wavelengths between 11 and 40 A. X-ray diffraction was used to follow the decay of the modulation on annealing for various periods of time at a constant temperature. The dependence of the observed diffusivities on wavelength for constant composition and temperature was found to agree with the new diffusion equation in which allowances are made for the effect of gradient energy and coherency strains on the driving force. This dependence established the gradient energy term. Values calculated from the diffusivities agreed very well with theoretical estimates of these parameters. The degree of coherency of the modulations was also determined from measurements of the ratio of low-angle to high-angle satellite intensity about a Bragg peak. Dissert. Abstr.

N70-23013*# Battelle Memorial Inst., Columbus, Ohio. Structural Materials Engineering Div.
FLAW GROWTH BEHAVIOR OF INCONEL 718 AT ROOM AND CRYOGENIC TEMPERATURE Final Report, 29 Apr. 1968-31 Oct. 1969
D. E. Pettit, C. E.Feddersen, and H. Mindlin 31 Oct. 1969 98 p refs Prepared for Bendix Corp., Davenport, Iowa
(Contract NAS9-7689)
(NASA-CR-101942) Avail: CFSTI CSCL 11F

The flaw growth characteristics of parent and welded Inconel 718 sheet and inturgeacently formed material were determined at room and cryogenic temperatures for surface-flawed specimens. Fracture tests, sustained-load tests, and fatigue-crack propagation tests were conducted for these conditions in various environments including trichlorofluroethane (Ucon 13), liquid nitrogen, liquid oxygen, and liquid hydrogen. The resulting data were then analyzed within the framework of linear elastic fracture mechanics. Author

N70-23022 Lehigh Univ., Bethlehem, Pa.
STRESS-RELIEF CRACKING IN LOW ALLOY STEEL WELDMENTS
Carl Frederick Meitzner (Ph.D. Thesis) 1968 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-7349

The problem of stress-relief cracking in structural steels was studied using the Lehigh restraint test as well as tensile and stress-relaxation specimens from material which had been subjected to a simulated HAZ cycle in the Gleeble. The mechanism of cracking was determined by extensive optical and electron microscopy, including examination of fracture surface faces. The majority of the work was conducted on two quenched and tempered steels (A517F and A517J) but several other commercial and experimental steels were used for comparative purposes. The results of this study indicate that stress-relief cracking occurs as a result of insufficient HAZ ductility for stress relaxation at stress-relieving temperatures. The experimental results strongly indicate that alloy carbide precipitation is responsible for this low ductility. Dissert. Abstr.

N70-23061# Advisory Group for Aerospace Research and Development, Paris (France).
ENGINEERING PRACTICE TO AVOID STRESS CORROSION CRACKING Conference Proceedings
Feb. 1970 256 p refs Mostly in ENGLISH; Partly in FRENCH Presented at Struct. and Mater. Panel 29th Meeting, Istanbul, 30 Sep.—1 Oct. 1969
(AGARD CP-53) Avail: CFSTI

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17. A REVIEW OF NONDESTRUCTIVE METHODS FOR EVALUATION OF RESIDUAL STRESS AND STRESS CORROSION R. B. Oliver (Union Carbide Corp., Kokomo, Ind.) 5 p refs (See N70-23068 10-17)

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N70-23062# Royal Aircraft Establishment, Farnborough (England).
THE EXAMINATION OF SERVICE FAILURES
P. J. E. Forsyth *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 23 p (See N70-23051 10-17)
Avail: CFSTI

A general introduction is presented to the phenomenon of stress corrosion, briefly describing the conditions under which it occurs, and putting the aircraft problem into perspective in relation to fatigue. A practical introduction to fractures analysis is also given, including those features of stress corrosion cracking upon which recognition is based, and relating them to the microstructures of the alloys concerned. The observational techniques that are available are reviewed, and their application in various service failure investigations discussed. Author

N70-23053# Battelle Memorial Inst., Columbus, Ohio.
THE RELATIVE INFLUENCE OF STRESS AND ENVIRONMENT ON TITANIUM ALLOYS
R. I. Jaffee *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 5 p (See N70-23051 10-17)
Avail: CFSTI

The environments to which titanium alloys are susceptible to stress corrosion cracking, the feasible means of control the problem, and the mechanisms of cracking are reviewed. The environments considered are sea water, nitrogen tetroxide, methanol, hot salt, red fuming nitric acid, halogenated hydrocarbons, ignition and burning, and liquid metals. N.E.N.

N70-23054# Aluminum Co. of America, New Kensington, Pa. Research Labs.
INFLUENCE OF STRESS AND ENVIRONMENT ON THE STRESS-CORROSION CRACKING OF HIGH STRENGTH ALUMINUM ALLOYS
Robert H. Brown, Donald O. Sprowls, and M. Byron Shumaker *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 27 p refs (See N70-23051 10-17)
Avail: CFSTI

Stress corrosion cracking is defined as cracking that is initiated by directional chemical and/or electrochemical attack synergized by sustained tension stress at the surface. It results when the following agents are present simultaneously: an enduring tensile stress at exposed surfaces, a specific composition, a unique microstructure, and a corrosive environment. Sustained tensile stresses at exposed surfaces are required for stress corrosion cracking to occur. The relationship of a critical stress level to stress intensity is under current investigation. Service failures of aluminum alloys by stress corrosion cracking are infrequent. These are generally caused by sustained surface tensile stresses introduced by fabrication or assembly procedures. The problems in aluminum alloys can be avoided by careful attention to manufacturing methods employed, by the choice of alloys and tempers, and by the adherence to sound design and assembly practices. Author

N70-23055# TRW Equipment Labs., Cleveland, Ohio.
CHARACTERISTICS OF ENVIRONMENTALLY-INDUCED DELAYED FAILURE IN HIGH STRENGTH STEELS
E. A. Steigerwald *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 24 p refs (See N70-23051 10-17) CFSTI

Particular emphasis is placed on the results obtained from precracked specimens using linear elastic fracture mechanics to define crack growth rates and the stress intensity parameter below which cracking was not observed. The addition of chlorides to water had only a relatively slight effect on delayed failure. The solution pH over the range of 3 to 10 also did not alter the environmental cracking characteristics. Dry hydrogen at one atmosphere was a particularly detrimental environment and produced crack growth rates that were greater than those obtained in moist air. In liquid environments increasing temperature produced an increase in crack growth rate with an activation energy equal to that observed for hydrogen embrittlement. The kinetics of the delayed failure process were significantly altered by variation in the steel composition. The high nickel maraging steels had the greatest resistance to environmental cracking. Metallurgical structure also exerted a significant effect on delayed failure characteristics. Low carbon martensite or bainite in which microtwinning was absent had greater resistance to environmentally-induced delayed failure. Author

N70-23056# Centre d'Essais de Propulseurs, Saclay (France).
MAGNESIUM-8% ALUMINUM ALLOY BEHAVIOR UNDER STRESS CORROSION [ETUDE DU COMPORTEMENT DE L'ALLIAGE MAGNESIUM-8% d'ALUMINUM EN CORROSION SOUS TENSION]
M. Vialatte *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 12 p refs In FRENCH (See N70-23051 10-17)
Avail: CFSTI

Tests were performed to determine the sensitivity of aluminum based alloys to stress corrosion, and the possibility of using such alloys in aeronautical constructions. A comparison was made of the smelting alloys having the same composition sensitivity. Magnesium-aluminum 8% alloy was shown to be sensitive to stress corrosion in the forge state, but not in the casting state. Emphasis is placed on the fissure found in the intergranulars and transgranulars. Transl. by J.M.C.

N70-23058# Hawker Siddeley Aviation, Ltd., Woodford (England).
SUSTAINED STRESSES AND THEIR EFFECT ON STRESS CORROSION CRACKING
J. Fielding and A. K. Redfern *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 14 p refs (See N70-23051 10-17)
Avail: CFSTI

The origin and magnitude of the stresses which have an important bearing on stress corrosion cracking are discussed, emphasizing cracks in aluminum alloys. The greatest danger arises when residual, assembly and service stresses combine to produce high tensile stresses. This coincidence of various stresses is often the main cause of stress corrosion failures. Data show that the total sustained stress may exceed the proof stress of the material. The first objective must always be to improve materials to remove susceptibility to stress corrosion cracking. It is however always desirable to reduce residual and assembly stresses to the minimum possible by attention to heat treatment, fabrication methods, and assembly techniques. Low stresses will always improve the position as regards fatigue and distortion during machining in addition to the residual stress corrosion hazards. Author

N70-23060# Frankford Arsenal, Philadelphia, Pa. Pittman-Dun Research Labs.
STRESS CORROSION TESTS ON WELDED CRUCIFORMS OF 7039-TYPE ALUMINUM ALLOY
F. Phillip, H. R. Pritchard, and H. Rosenthal *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 10 p (See N70-23051 10-17)
Avail: CFSTI

Tests are described which were made to assess the degree of stress corrosion cracking susceptibility under various weld conditions and to point out the relative effectiveness of different protective measures. Tests were conducted in an accelerated alternate-immersion test environment, and in outdoor exposures in marine and industrial environments. Data indicate that short transverse stubs of susceptible aluminum alloys will crack by stress corrosion when stressed by adjacent welds. The distance of the stub face from the weld is critical in determining susceptibility or immunity. The tests also indicate that effective protection is afforded by shot peening or overlaying welding. Overlay welding is preferred because inspection is simple and the results are assured. A 0.75 inch stub length on a cruciform sample was more susceptible to stress corrosion than a 1.25 inch stub. Stubs of 2.25 and 3.25 inches were immune for the three year period. Author

N70-23062# Hawker Siddeley Aviation, Ltd., London (England).
THE CHOICE OF MATERIALS
G. B. Evans *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 12 p refs (See N70-23051 10-17)
Avail: CFSTI

A means of developing the design of a part, as it influences the choice of material, which can lead to manufacture and service operation without stress corrosion cracking is described. The different degrees of sensitivity to stress corrosion cracking which can arise in material from small differences of composition heat treatment and coldwork are discussed. The importance of careful consideration and control at all stages is emphasized. An attempt is made to obtain an overall appreciation of the importance of stress corrosion and the other important aspects such as fatigue. It is suggested that all the features necessary to avoid stress corrosion cracks assist with the other problems also, and are good practice even when there is a material of high stress corrosion resistance which would fit the design need. Author

N70-23064# Advisory Group for Aerospace Research and Development, Paris (France).
THE INFLUENCE OF SURFACE AND PROTECTIVE TREATMENTS ON STRESS CORROSION BEHAVIOUR
H. G. Cole *In its* Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 11 p refs (See N70-23051 10-17)
Avail: CFSTI

Data are presented on magnesium alloys, aluminum alloys, titanium alloys, and low alloy and stainless steels. Compressive surface stresses introduced by peening are beneficial on all metals. Sacrificial metal protective coatings are beneficial on all metals except low alloy steels in a state highly sensitive to hydrogen. Conversion coatings give little protection alone or may be deleterious but in conjunction with high grade paint schemes give fair protection. Brief recommendations are added for the application of existing knowledge. Author

N70-23066# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
STATUS OF RESEARCH ON STRESS CORROSION CRACKING
A. M. Lovelace *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 8 p (See N70-23051 10-17)
Avail: CFSTI

Industrial testing and research programs are briefly discussed. Industrial tests are aimed at solving specific fabrication or metallurgical problems, or at developing protection measures. Research programs are concerned with environmental effects on mechanical properties of metals, alloy, and nonmetallic materials, and with the mechanisms of stress corrosion cracking. The expected benefits of research for aircraft engineers and designers are described. N.E.N.

N70-23067# Industrieanlagen-Betriebsgesellschaft M.B.H., Ottobrunn (West Germany). Laboratorium fuer Festigkeit und Schwingungen.
DETERMINATION OF RESIDUAL STRESSES BY INDENTATION HARDNESS TESTING
B. Stengel and Th. Gaymann *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 7 p refs (See N70-23051 10-17)
Avail: CFSTI

A quasi-nondestructive method of determining residual stresses by measuring changes in hardness is described. Indentations in stressed and unstressed metal parts are compared. The sources of error are identified as reference hardness, scatter of hardness, inclination and curvature of test piece surface, texture influences, plated surfaces, elastoplastic deformations, and quenching effects. Stress sensitivity and accuracy are also considered. N.E.N.

N70-23068# Union Carbide Corp., Kokomo, Ind. Materials Systems Div.
A REVIEW OF NONDESTRUCTIVE METHODS FOR EVALUATION OF RESIDUAL STRESS AND STRESS CORROSION
Robt. B. Oliver *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 5 p refs (See N70-23051 10-17)
Avail: CFSTI

Nondestructive testing methods are described for detecting stress corrosion cracks, residual stresses, and stress corrosion susceptibility. Abstracts of recent papers are presented on existing methods, including new ways based on eletrode potential, electron emission, proton annihilation, and nuclear resonance. N.E.N.

N70-23069# Technische Hochschule Aachen (West Germany).
DETERMINING RESIDUAL STRESS IN TITANIUM AND TITANIUM ALLOY BY X-RAYS
F. M. Bollenrath, W. Froehlich, and V. Hauk *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 9 p refs (See N70-23051 10-17)
Avail: CFSTI

Theoretical considerations and experimental results in measuring stress and strain in hexagonal crystals by X-ray diffraction are presented. An equation is developed for the X-ray residual stresses induced by plastic deformation and the X-ray inherent strain. Test data are given on the X-ray coefficients, dependance of crystallographic planes on orientation, influence of strain rate, residual lattice strain, and scatter ranges. It is concluded that high residual compression stresses in microscopic areas in surface and subsurface layers result from plastic strain in tensile specimens. Permanent nominal compression strain induces corresponding residual tensile stresses. N.E.N.

N70-23070 IIT Research Inst., Chicago, Ill.
FIELD ION-EMISSION STUDIES OF THE INITIAL STAGES OF TUNGSTEN OXIDATION
Conrad Joseph Polk (Ph.D. Thesis) 1968 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-2252

A combined field ion-emission microscope was used to study the initial stages of oxidation on tungsten substrates as a function of the degree of order present on the surfaces. Reactions were conducted in pure oxygen atmospheres under pressure at surface temperatures of 700 C and 900 C. Results obtained in the emission microscope demonstrated that the degree of surface order influenced the nucleation of oxide particles which formed on the tungsten surface during the oxidation process and that certain crystallographic regions were preferred as oxide formation sites. Observations of the oxidized surfaces in both the emission and ionization modes of operation also indicated that the oxide particles grew below the metal surface, as evidenced by the presence of deep pits observed during field evaporation of the oxidized surfaces. The presence of these pits indicated that oxygen diffused into the surface to continue the growth of the oxide particle. Dissert. Abstr.

N70-23073# Aeronautical Research Labs., Melbourne (Australia).
THE RELATIONSHIP BETWEEN AGED STRUCTURE AND THE FATIGUE BEHAVIOUR OF ALUMINIUM ALLOYS. PART 1: LITERATURE REVIEW
J. M. Finney Jun. 1969 47 p refs
(ARL/SM-324) Avail: CFSTI

Aging and fatigue processes in aluminium alloys is reviewed. Only those aspects of the aging process which concern the physical structures produced are considered. The interaction of dislocations with these structures is considered as a preliminary to understanding their fatigue behaviour. The fatigue of metals is covered in quite general terms, and this is followed by the fatigue of age-hardened aluminium alloys. Author

N70-23205*# Boeing Co., Seattle, Wash. Aerospace Systems Div.

FRACTURE AND NITROGEN TETROXIDE/SUSTAINED LOAD FLAW GROWTH OF 6Al-4V TITANIUM Final Report, 5 May - 3 Sep. 1969

J. N. Masters, W. P. Haese, and W. D. Bixler Oct. 1969 46 p refs Prepared for JPL

(Contract NAS7-100)

(NASA-CR-109366; D2-121397-1) Avail: CFSTI CSCL 11F

The static fracture and sustained load flaw growth characteristics were evaluated experimentally for 6Al-4V titanium forgings and weldments. Fracture toughness tests were performed in air at room temperature and in liquid nitrogen at -320 F. The sustained load tests were conducted in nitrogen tetroxide at a temperature of 80 to 90 F. It was concluded that the fracture toughness of 6Al-4V titanium is (1) moderately dependent on material heat, (2) lower with decreasing temperature, and (3) a minimum in the weld heat affected zone. It was also concluded that the threshold stress intensity in nitrogen tetroxide at 80 to 90 F is above 28.0 ksi per sq inch, independent of material heat or flaw location. Author

N70-23214# Army Materials and Mechanics Research Center, Watertown, Mass.

ATTENUATION OF RADIANT ELECTROMAGNETIC ENERGY IN TUNGSTEN AND SILVER FOR THE INFRARED AND X-RAY REGIONS Technical Report

Albert F. Grenis Oct. 1969 20 p refs

(AD-698465; AMMRC-TR-69-23) Avail: CFSTI CSCL 20/12

The attenuation characteristics of selected metals for electromagnetic radiation were investigated over a broad region of the electromagnetic spectrum. An analytical study was made to determine the attenuation of radiant electromagnetic energy as it is absorbed by metals, such as tungsten and silver, and to determine the depth of penetration of the electromagnetic energy within these metals at elevated temperatures. The electromagnetic spectral region of interest extended from 0.00001 to 1000 microns. The temperature ranges examined were from room temperature to 2800 K for tungsten and to 1000 K for silver. Author (TAB)

N70-23278*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INFLUENCE OF FIBER ASPECT RATIO ON THE STRESS-RUPTURE LIFE OF DISCONTINUOUS FIBER COMPOSITES

Robert W. Jech Washington Apr. 1970 24 p refs

(NASA-TN-D-5735; E-5407) Avail: CFSTI CSCL 11D

An investigation of the effect of critical aspect ratio on the stress-rupture life of discontinuous fiber reinforced composites was carried out. Pull-out specimens of tungsten wire and copper were tested at 1200 and 1500 F for nominal stress-rupture times of 1, 10, and 100 hr. The observed critical aspect ratios were greater than in short-time tensile tests but were within the same order of magnitude at temperatures as high as 1500 F. Failure time of the specimens was controlled by the properties of the matrix (copper) at ratios less than the critical aspect ratio and by the properties of the fiber (tungsten) at aspect ratios greater than the critical aspect ratio. Author

N70-23279*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PREPARATION OF FIBERED CERAMICS BY MECHANICAL DEFORMATION

Robert W. Jech, John W. Weeton, and Robert A. Signorelli Washington Apr. 1970 28 p refs

(NASA-TN-D-5736; E-5302) Avail: CFSTI CSCL 11B

Preparation of ceramic fibers by extrusion of ceramic particles in a metal matrix is described. Various oxides in the form of powder or spheres were used as the starting material. Extrusion was carried out at temperatures of 3600 or 4000 F. Fibers of zirconium oxide, hafnium oxide, and thorium oxide were produced by single extrusion. Reextrusion of fibers resulted in further reductions in their cross section and a corresponding increase in length. Fibers were removed from the tungsten and examined for grain size and grain orientation by X-ray diffraction. Fiber aspect (length to diameter) ratios were compared to predict values based upon the extrusion ratio. Author

N70-23281*# Whittaker Corp., West Concord, Mass. Nuclear Metals Div.

PRODUCTION OF OXIDE FIBERS BY CO-REDUCTION Final Report

P. Loewenstein and C. Zenuk Jul. 1969 107 p

(Contract NAS3-10499)

(NASA-CR-72616; NM-9800.13) Avail: CFSTI CSCL 11F

The objective of this work was to study the plastic deformation of metal oxides by high temperature extrusion in a matrix of molybdenum and tungsten. Irregular polycrystalline powder particles of six different oxides and single crystal spheres of one oxide were extruded with theoretical elongations of 9, 81, and 729 times, at temperatures between 58 percent and 96 percent of their absolute melting point. It was shown that the molybdenum matrix was too soft to deform the oxides. The spherical single crystal material did not deform under any circumstances. The polycrystalline oxides all deformed in the tungsten matrix, but the amount of deformation did not approach the deformation of the matrix. Most of the fibers formed were irregular and extremely fragile. Author

N70-23323*# Aerojet-General Corp., Sacramento, Calif. Research and Technology Dept.

CORRELATION OF STRESS-WAVE-EMISSION CHARACTERISTICS WITH FRACTURE IN ALUMINUM ALLOYS, 1 SEPTEMBER - 1 DECEMBER 1969

C. E. Hartbower, A. T. Green, and P. P. Crimmins Dec. 1969 85 p refs

(Contract NAS8-21405)

(NASA-CR-102562; Rept-1248-Q-5) Avail: CFSTI CSCL 11F

The correlation of stress-wave-emission characteristics with fracture in selected aluminum alloys was investigated. The cryogenic testing of part-through-cracked tension specimens was accomplished, the plane-strain fracture toughness was determined by computer, and the stress-wave data were analyzed. Author

N70-23332# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABRUPT DECREASE IN TITANIUM PLASTICITY AT HIGH TEMPERATURES

B. A. Kolachev et al 6 Aug. 1968 11 p refs Transl. into ENGLISH from Tr. Aviats. Tekhnol. Inst. (Moscow), no. 66, 1966 p 96-102

(AD-698515; FTD-HT-23-346-68) Avail: CFSTI CSCL 11/6

An investigation showed that an abrupt drop in plasticity is observed in vacuum-treated titanium in the 300-500C interval. In titanium saturated with hydrogen, hydrogen brittleness is superimposed on this drop at low rates of stretching. The hydrogen brittleness is caused by directional diffusion of hydrogen toward imperfections of the crystal structure and toward grain boundaries. The effect of hydrogen on titanium properties in this interval of temperatures is similar to strain aging. Author (TAB)

N70-23335# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BAUSCHINGER EFFECT IN LOW-CARBON STEEL DURING PURE SHEAR

G. B. Talypov 15 Aug. 1969 7 p refs Transl. into ENGLISH from Issled. Uprugosti Plast. (Leningrad), no. 5, 1966 p 246-248

(AD-698516; FTD-HT-23-808-68) Avail: CFSTI CSCL 11/6

Reverse torsion tests were made of thin wall tabular specimens. With a preliminary deformation to 3 percent, the Bauschinger effect varies with deformation parabolically, at approximately 3 percent, the effect remains unchanged. Formulas were derived for the instantaneous radius of curvature of the flow boundary. The agreement between the theoretical and experimental results is good. It is believed that the hypothesis of translational isotropic softening and hardening should replace the theory that considers the hardening only. Author (TAB)

N70-23383*# Union Carbide Corp., Indianapolis, Ind. Materials Systems Div.
SUPERALLOY BY POWDER METALLURGY FOR USE AT 1000 –1400 F Final Report
P. S. Kotval 31 Dec. 1969 65 p refs
(Contract NAS3-13214)
(NASA-CR-72644; Rept-70-7691) Avail: CFSTI CSCL 11F

Argon atomized nickel-base alloy powders of two compositions were consolidated by extrusion and processed thermomechanically. The compositions are strengthened by precipitation of the body-centered-tetragonal Ni3Ta or Ni3Cb phases. Microstructural observations indicated good stability for the Ni3Ta phase up to 1400 F. Mechanical property measurements showed a tensile yield strength of 189,000 psi at 1200 F for the alloy strengthened by the Ni3Ta phase with greater than 10 percent elongation. Author

N70-23407# Oak Ridge National Lab., Tenn.
RADIATION METALLURGY SECTION, SOLID STATE DIVISION Progress Report, Period Ending Oct. 1968
M. S. Wechsler Apr. 1969 62 p refs
(Contract W-7405-eng-26)
(ORNL-4369) Avail: CFSTI

The impact machines in the laboratory and hot cell were fitted with strain gages whose calibrated output registers the load applied to the sample during impact. The general yield load, the maximum load, and the fracture load were evaluated as a function of test temperature for unirradiated steel and for steel irradiated at three temperatures. Unirradiated and irradiated steels were observed by optical and electron microscopy including electron fractography by replication of the fracture surfaces. Thin foils of unirradiated and irradiated steel specimens were examined by transmission electron microscopy. Impact and tensile tests were performed in irradiated and unirradiated steel specimens. Three aspects of radiation hardening in Fe are described: temperature dependence, fluence dependence, and the effect of interstitial solutes. Measurements of resistivity and internal friction were made on irradiated V. Author

N70-23481# National Bureau of Standards, Washington, D.C.
STANDARD REFERENCE MATERIALS: ANALYSIS OF INTERLABORATORY MEASUREMENTS ON THE VAPOR PRESSURE OF GOLD (CERTIFICATION OF STANDARD REFERENCE MATERIAL 745)
Robert C. Paule and John Mandel Jan. 1970 19 p refs *Its* Spec. Publ. No. 260-19
Avail: SOD $2.50

A detailed statistical analysis made of results obtained from a series of interlaboratory measurements on the vapor pressure of gold. The gold standard reference material 745 which was used for the measurements was certified. The temperature range corresponding to pressure is 1300 –2100 K. The gold heat of sublimation at 298 K and the associated standard error were found to be 87,720 + or – 210 cal/mol (367,040 + or – 900 J/mol). Estimates of uncertainty were calculated for the certified temperature-pressure values as well as for the uncertainties expected from a typical single laboratory's measurements. The statistical analysis was also made for both the second and third law methods, and for the within and between laboratory components of error. Several notable differences in second and third law errors are observed. Author

N70-23484# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
EFFECT OF FLUID FLOW ON SOLIDIFICATION STRUCTURE Technical Report
M. C. Flemings, D. B. Spencer, and R. Mehrabian Nov. 1969 110 p refs
(Contract Nonr-3963(09))
(AD-698274; TR-3) Avail: CFSTI CSCL 11/6

The report summarizes five interrelated but separate investigations on effect of fluid flow on solidification structure. The first chapter is an analytic investigation of effect of gravity on macrosegregation. The second chapter deals with effects of turbulent convection on the growth structure of horizontally grown Al-CuAl2 eutectic alloy. The third chapter reports work on composite solidification of aluminum-copper eutectic alloys. The fourth chapter is on the solidification of ice dendrites in flowing supercooled water. The fifth chapter is a progress report of current work on the effect of vigorous convection on solidification structures. TAB

N70-23545 National Lending Library for Science and Technology, Boston Spa (England).
A NEW MAGNETIC ALLOY WITH REDUCED NICKEL CONTENT
V. M. Kuznetsov et al 22 Oct. 1969 4 p refs Transl. into ENGLISH from Elektrotekhn. (USSR), no. 6, 1968 p 39 –41 In ENGLISH and RUSSIAN
(NLL-LTI-746-310-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

An investigation was carried out to determine the influence of alloying with titanium, manganese and niobium on the magnetic properties of an alloy containing 15% cobalt, 15% nickel, 8-10% aluminum and 3-4% copper. The simultaneous alloying with titanium (0.6%), manganese (1.0%) and niobium (0.5%) allowed the nickel content of the alloy Yu NDK15 to be lowered from 20 to 15% without loss of magnetic properties. Author

N70-23590# Bristol Aerojet, Ltd., Banwell (England).
THE EFFECT OF COMPOSITION AND TENSILE STRENGTH ON THE SUSCEPTIBILITY OF ALLOY STEELS TO CADMIUM PLATING (HYDROGEN) EMBRITTLEMENT
P. F. Langstone London Min. of Technol. Oct. 1968 36 p refs
(Contract KS/1/0207/C.B.43(a)2)
(D-MAT-159) Avail: CFSTI

Sustained load, fracture, toughness, and bend tests were made to determine the susceptibility to cadmium plating (hydrogen) embrittlement of a range of 3 percent chromium-molybdenum-vanadium steels of different carbon contents, impurity contents, and tensile strengths. Comparison was made with 2 percent copper-silicon-molybdenum steels and 18 percent nickel maraging steels. Sustained load life and critical crack size fell sharply with increase of tensile strength from 110 to 120 tons/sq in. Variation in carbon content at constant tensile strength had little effect. Most impurity elements were somewhat detrimental but 0.016 percent sulphur appeared beneficial. Extension of baking times at 200 C after plating prolonged sustained load life but did not always eliminate failure. The maraging steels were much more resistant to plating embrittlement than the two low alloy steels. Author (ESRO)

N70-23691# Ferranti, Ltd., Dundee (Scotland).
THE EVALUATION OF D50S ALUMINIUM ALLOY WIRE WRAPPED JOINTS
D. W. Halley Sep. 1969 88 p
(Contract KJ/F/4434/C.B.55(c)3)
(TIL-BR-15451) Copyright. Avail: CFSTI

The performance of wire-wrapped joints using D50S aluminium alloy wire on posts of monel, nickel silver, phosphor bronze, and B26S aluminium alloy was assessed. Comparison is made with similar joints using tinned copper wire. Both types of joints on each

of the post materials proved suitable at conductor temperatures up to 105 C. D50S wire on B26S posts showed excellent characteristics up to 260 C. D50S wire on nickel silver posts was also satisfactory at this temperature but similar joints on monel and phosphor bronze were unsatisfactory. Tinned copper wire on monel, nickel silver, and phosphor bronze posts was suitable at 260 C, but not on B26S posts at this temperature. Both types of joints on the four post materials withstood all standard environmental conditions apart from salt mist. Author (ESRO)

N70-23619 National Lending Library for Science and Technology, Boston Spa (England).
REPEATED MECHANICAL-HEAT TREATMENT OF IRON AT DIFFERENT AGING TEMPERATURES AND RATES OF DEFORMATION [MNOGOKRATNAYA MEKHANIKO-TERMICHESKAYA OBRABOTKA ZHELEZA PRI RAZLICHNYKH TEMPERATURAKH STARENIYA I SKOROSTYAKH DEFORMIROVANIYA]
L. K. Gordienko et al. Nov. 1969 13 p refs Transl. into ENGLISH from Fiz. i Khim. Obrabotki Mater. (USSR), no. 1, 1968 p 71–75
(NLL-RTS-5371) Avail: Natl. Lending Library, Boston Spa, Engl.: 12s 6d or 2 NLL photocopy coupons

The effects of deformation rate and aging temperature on the mechanical properties of commercial iron were investigated. The samples were deformed at room temperature to the termination of the yield plateau and aged for two hours under a stress of 1 kg/sq mm higher than the yield point. In the first series of treatments the aging temperature was varied from 373 to 473 K at a constant, slow rate of extension, and in the second series the rate of deformation was altered and the temperature was constant. Increase in the aging temperature promotes more complete stabilization of the structure in the iron and causes an additional increase in the yield point. An increased deformation aging temperature does not result in a significant lowering of the plasticity on carrying out repeated mechanical-heat treatments with a low rate of deformation. Increase in the rate of deformation from .00000225 to .000225/sec results in a certain growth of the hardening effect which is evidently the result of increased frictional stress, but during this a sharper fall in the plasticity of iron in the strengthened state is observed. Author

N70-23627# Ohio State Univ. Research Foundation, Columbus.
STRESS CORROSION CRACKING OF Fe-Cr-Ni ALLOYS IN CAUSTIC ENVIRONMENTS Quarterly Report, 16 Apr.–15 Jul. 1969
R. W. Staehle 22 Aug. 1969 8 p
(Contract AT(11-1)-2018)
(COO-2018-5) Avail: CFSTI

The susceptibility of Cr-Fe-Ni alloys to stress corrosion cracking in caustic environments was studied. A prototype cell for stress corrosion tests in boiling NaOH solutions was constructed. It operated satisfactorily in preliminary tests. A prototype cell for polarization measurements in caustic solutions was constructed and awaits testing. NSA

N70-23628 Maryland Univ., College Park.
SOLID SOLUTION HARDENING IN FACE CENTERED CUBIC BINARY ALLOYS
Bisuddhi Ronnapakas Riddhagni (Ph.D. Thesis) 1968 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-7626

The increase in critical resolved shear stress was calculated for concentrated solid solution binary alloys due to differences in modulus and size of the constituent elements. The approach used is a statistical one. In a concentrated alloy, as the dislocation moves it will experience random fluctuations in energy due to local changes in modulus and size of the various types of atoms. The dislocation will become slightly kinky so as to take on a minimum energy configuration. The variance in energy associated with a movement of the double kink segment is calculated. Then the most probable energy fluctuation encountered during the double kink motion due to changes in modulus and size of different atoms is determined. There is some typical double kink size that can be calculated using probability theory and balancing line tension against self energy. Dissert. Abstr.

N70-23629# Bureau of Mines, Washington, D.C.
INFLUENCE OF ROLLING TEMPERATURE AND COPPER CONTENT ON CREEP AND OTHER PROPERTIES OF ZINC-COPPER AND ZINC-TITANIUM-COPPER ALLOYS
L. A. Neumeier and J. S. Risbeck Apr. 1970 49 p refs
(RI-7363) Avail: Issuing Activity

An evaluation was made of the properties and anisotropy in properties of rolled Zn-Cu and Zn-0.12 pct Ti-Cu alloys with various copper additions to 1.25 pct. The alloys were rolled cold and at various hot-rolling temperatures to reductions as high as 92 pct after breakdown rolling. The properties are extremely sensitive to various combinations of composition, rolling temperature, and rolling reduction. The Zn-Cu alloys can develop good creep resistance, but they are inferior in that respect to Zn-Ti-Cu alloys. For alloys either with or without the titanium addition, cold-rolling results in recrystallization of the matrix and rejection of copper from solution, causing poor hardness, tensile, and creep properties, but high ductility. Peak tensile strengths develop when the alloys are rolled in the range 320 to 400 F. Best creep resistance for Zn-Cu alloys requires higher rolling temperatures when copper content is increased. Creep resistance is best for Zn-Ti-Cu alloys with about 0.75 to 1.0 pct Cu rolled near 480 F. The possible contributions to creep behavior of factors such as distribution of second-phase particles, grain size, and preferred orientation are discussed. Author

N70-23679# Bureau of Mines, Rolla, Mo. Metallurgy Research Center.
REACTION OF Co-Ni-V ALLOYS WITH O2 AT 1351 TO 1429 K
Robert M. Doerr and J. W. Jensen Apr. 1970 23 p refs
(BM-RI-7371) Avail: Issuing Activity

The effect of vanadium alloy additions on the oxidation behavior of cobalt-nickel alloys was determined. Eighteen alloys were reacted with O sub 2 at 0.5 atm and 1,351, 1,389, and 1,429 K. The alloy compositions consisted of Co-Ni master alloys (0, 22, 50, 70, 91, and 100 wt pct Ni) with V additions of 0, 0.9, and 2.7 wt pct. Large early deviations from, or changes in, the parabolic rate constant were encountered, but the reaction rate in most cases declined approximately in accordance with the parabolic rate law. Relatively, the vanadium degraded the oxidation resistance most at the highest nickel contents. In some cases, melting of the oxide was inferred from microscopic evidence and X ray diffraction measurements disclosed the presence of low-melting vanadates. Author

N70-23683 National Lending Library for Science and Technology, Boston Spa (England).
A STUDY OF THE STRUCTURE OF ELECTRODEPOSITED Au-Cu AND Au-Cu-Cd ALLOYS. [Au-Cu KEI GOKIN MEKKI NO SEKISHUTSU KOZO NO KENKYU]
S. Kamai et al. Nov. 1969 11 p refs Transl. into ENGLISH from Kinzoku Hyomen Gijutsu (Japanese), v. 19, no. 9, 1968 8 p
(NLL-RTS-5421) Avail: Natl. Lending Library, Boston Spa, Engl.: 12s 6d or 2 NLL photocopy coupons

Measurements of the microstructure of Au-Cu-Cd electroplating were carried out by X-ray diffraction and electron microscopy. In addition an investigation was made of mechanical properties of the precipitation layer, such as its hardness and resistance to wear and chemical properties, such as acid resistance, and oxidation resistance. It was found that in Au-Cu plating when the pH of the

plating bath is 10, the precipitation layer is a mixture of crystals of gold and copper and that the two metals do not form a solid solution. It was deduced that in Au-Cu-Cd plating when the gold content is 18 K or higher an even solid solution is formed by the three constituent metals. It was found that the addition of cadmium caused the hardness of the precipitation layer to reach as much as H sub V 200 with excellent resistance to wear. Furthermore a precipitation layer was obtained which was impenetrable by nitric acid and underwent no change when oxidized at high temperatures.
Author

N70-23693# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
X-RAY STUDIES OF NICKEL FILMS DEPOSITED BY EVAPORATION. PART 1: TEXTURE CHARACTERISTICS [ROENTGENOGRAPHISCHE UNTERSUCHUNGEN AN AUFGEDAMPFTEN NICKELFILMEN. 1. TEXTUREIGENSCHAFTEN]
G. Wedler et al Nov. 1969 16 p refs Transl. into ENGLISH from Z. Naturforsch. (Tubingen), v. 23a, 1968 p 1537–1543 Prepared for Lincoln Lab., MIT
(AZT-69-592-GELL) Avail: CFSTI

Nickel films with layer thicknesses between 100 and 400 A were deposited by evaporation under various conditions on to tempax glass carriers and were subsequently radiographically examined with the aid of a texture analyzer. It was shown that the texture characteristics of the films are strongly influenced by layer thickness and tempering temperature. While the crystallites in mildly tempered films do not manifest a noticeably preferred orientation, in the case of highly tempered films a (111) fiber texture is found which is strongly pronounced, especially in the case of great layer thicknesses. It can be traced back to the fact that during tempering the crystallites oriented toward (111) grow preferentially under the influence of the differing thermal expansion coefficients of film and base.
Author

N70-23707# Massachusetts Inst. of Tech., Cambridge.
X-RAY AND NEUTRON DIFFRACTION STUDIES OF METALS AND ALLOYS Final Report, 1 Jan. 1966–30 Aug. 1969
David P. Shoemaker 1 Dec. 1969 13 p refs
(Contract DA-31-124-ARO(D)-348)
(AD-698473; AROD-5382-7-MC) Avail: CFSTI CSCL 20/2

X-ray crystal structure work on the M phase Nb-Ni-Al, was completed. This orthorhombic structure (Pnam, 52 atoms) shows close relationship to the P and nu phases. The crystal structure of the nu phase, Mn81.5 S118.5, was determined and refined to a high degree of precision. This is the most complex structure yet determined in this program, having 186 atoms in an orthorhombic unit cell (Immm). This structure, too, is closely related to the P phase. A third orthorhombic structure (Pnnm, 74 atoms) has been determined for the Q(X,Y) phase in Mn-Co-Cr. A rough trial structure was obtained for the monoclinic K phase, Fe-Mn-Si. The structures of the monoclinic I phase (V-Ni-Si) and the S phase (Mn-Co-Si) are probably identical. A new scheme for coding layered tetrahedrally close-packed structures was developed. Reinterpretation of polarized-beam neutron diffraction data for 85% ordered VFe, 46.7 at.% Fe, has given an improved value for the Fe spin, S sub Fe = 0.368 + or −0.024; the spin on the vanadium is zero within experimental error. Previous indications of a highly aspherical 3d shell on ion were not substantiated. Attempts to prepare single crystals of sigma CoV for polarized beam single crystal neutron studies were unsuccessful.
Author (TAB)

N70-23715# Aztec School of Languages, Inc., Maynard, Mass.
RADIOGRAPHIC INVESTIGATIONS OF NICKEL FILMS DEPOSITED BY EVAPORATION. PART 2: DEPENDENCE OF THE FILM STRUCTURE ON LAYER THICKNESS [ROENTGENOGRAPHISCHE UNTERSUCHUNGEN AN AUFGEDAMPFTEN NICKELFILMEN SCHICHTDICKENABHANGIGKEIT DER FILMSTRUKTUR]
G. Wedler and P. Wissmann Oct. 1969 13 p refs Transl. into ENGLISH from Z. Naturforschung, (Germany), v. 23A, 1968 p 1544–1548 Prepared for Lincoln Lab., MIT
(AZT-69-593-GELL) Avail: CFSTI

Nickel films in the layer-thickness range of 100 to 4000 A are deposited by evaporation under ultrahigh vacuum conditions at 77 K onto tempax-glass carriers, tempered at 210 C and subsequently radiographically investigated in the atmosphere at 20 C. Evaluation with respect to the reflex width as well as to the angle position of reflex maxima shows that the films do not contain any noticeable stacking flaws. The [111]-oriented crystallites are always larger than the [200] and [311]-oriented ones. The mean size of the [111]-oriented crystallites corresponds here approximately to the layer thickness. The lattice constants measured for the films are diminished in comparison to those of the compact material. This effect is due to a contraction of the lattice in the direction perpendicular to the film plane under the influence of the differing thermal expansion coefficients of the film and base. The extent of the lattice contraction is a function of the layer thickness.
Author

N70-23717 National Lending Library for Science and Technology, Boston Spa (England).
MAGNETIC PROPERTIES OF INTERNALLY OXIDIZED ELECTROTECHNICAL STEEL E1
E. V. Mukhaeva et al 22 Oct. 1969 3 p refs Transl. into ENGLISH from Fiz. Metallov Metalloved. (USSR), v. 26, no. 4, Oct. 1968 p 739–741 In ENGLISH and RUSSIAN
(NLL-Trans-746-251-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A supplementary investigation of the magnetic properties of E1 (1.3% Si, 0.06% C) steel specimens having an internal-oxidation zone (IOZ) in the absence of an external oxide film is described. The oxidation technique, the IOZ structure, and the measurement of magnetic properties were previously described. Specimens chosen for investigation, machined from sheet in the direction of rolling, were 250 × 30 × 0.35 mm in size. Compared with unoxidized material, the appearance of an IOZ with a depth of as little as 15 to 20 microns substantially alters the magnetization curve. The point of intersection of the magnetization curves for the oxidized and unoxidized specimens moves towards weaker fields with increase in the depth of IOZ. The appearance of an IOZ results in a decrease in the maximum value of magnetostriction. For specimens subjected to thorough oxidation, a change in the sign of magnetostriction is observed.
Author

N70-23770# London Univ. (England).
A COMPARATIVE STUDY OF EXTRAPOLATION METHODS FOR CREEP DATA AT SMALL STRAINS
J. C. Levy and I. I. Barody HMSO 1969 32 p refs Supersedes ARC-29917
(ARC-R/M-3610; ARC-29917) Copyright. Avail: CFSTI

Methods of extrapolating creep and rupture data, including the direct use of stress-time charts, the Graham-Walles method, and the time-temperature parameters are reviewed. Creep data for aluminum alloy DTD 5070A are presented between temperatures of 100 C and 255 C, stresses between 5 and 21 ton/sq. in., and times of up to 5000 hours; the main interest centered on strains of up to 0.2 per cent. Based on these results there was little to choose between the various parametric methods for interpolation and for limited extrapolation. For longer extrapolation, up to 30 000 hours, the Graham-Walles method provided a convincing guide to the expected upper limit of performance. Of the parametric methods, the Dorn expression appeared to be the least unsatisfactory.
Author (ESRO)

N70-23781 National Lending Library for Science and Technology, Boston Spa (England).

INVESTIGATION OF PALLADIUM-RUTHENIUM ALLOYS

O. A. Novikova 22 Oct. 1969 7 p Transl. into ENGLISH from Tr. Inst. Met. Im. A. A. Baikova, Akad. Nauk SSSR (Moscow), no. 11, 1962 p 155–163 In ENGLISH and RUSSIAN

(NLL-Trans-746-258-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Problems are considered which involve the solubility of ruthenium in palladium and the effect of this solubility on the mechanical and electrical properties of palladium and on the workability of the alloys. An attempt was made to obtain confirmation for the prevailing view that mechanical working of palladium-ruthenium alloys is possible only at ruthenium contents below 15 wt.%. At higher ruthenium concentrations, the alloys resemble high alloy cast irons. For the investigation, alloys with 0.5, 1, 2, 3, 5, 8, 12, 15, 17, 20 and 30 wt.% ruthenium were prepared in a high frequency furnace. It should be noted that ruthenium-palladium alloys (with up to 15% Ru) melt at a temperature which is very close to the melting point of pure palladium; no metal growth or swelling phenomena, which are typical of palladium, were observed during cooling; the ingots were dense, had a homogeneous, fine-grained structure and were of an attractive matt-grey color. When conducting thermal analysis in order to construct the solidus line of the melting diagram, use was made of a Kurnakov pyrometer and a Rh/Pt-20% Rh differential thermocouple permitting temperature measurements up to 2000 C.

Author

N70-23787# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

X-RAY DETERMINATION OF THE CHARACTERISTIC DEBYE TEMPERATURE OF POLYCRYSTALLINE COPPER AND ALPHA-BRASS [ROENTGENOGRAPHISCHE BESTUMMING DER CHARAKTERISTISCHEN DEBYE-TEMPERATUR VON VIELKRISTALLINEM KUPFER UND ALPHA-MESSING]

Josef Sedivy et al Nov. 1969 11 p refs Transl. into ENGLISH from Z. Metallkunde (Russian), v. 59, no. 6, 1968 p 496–498 Prepared for Lincoln Lab., MIT

(AZT-69-632-GELL) Avail: CFSTI

In the present paper a new value of the Debye temperature of copper is given, which was found with a one-temperature X-ray agreement with the values given in the literature for earlier investigation. By the same method, θ was determined for the first time for brass containing 7.7 and 25.2 at–% Zn, respectively. After a correction according to Borie, $\theta = 291$ K and $\theta = 274$ K can be considered reliable values of the appropriate Debye temperatures in the sense of the discussion.

Author

N70-23791 National Lending Library for Science and Technology, Boston Spa (England).

MARTENSITIC TRANSFORMATION DURING THE PLASTIC DEFORMATION OF AUSTENITIC IRON-NICKEL-BASE ALLOYS

L. G. Zhuravlev et al 22 Oct. 1969 5 p refs Transl. into ENGLISH from Fiz. Metallov Metalloved. (USSR), v. 27, no. 3, Mar. 1969 p 478–483 In ENGLISH and RUSSIAN

(NLL-Trans-746-241-(9022.401)) Avail : Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A study was made of the effects of aluminum, silicon, manganese and chromium on martensite formation during plastic deformation in Fe-27% Ni alloys. All the elements investigated lower the M' sub d temperature and, even more effectively, the M sub s temperature. Manganese increases, while silicon and chromium decrease, the amount of martensite forming at deformation temperatures equidistant from M' sub d. The influence of aluminum is negligible.

Author

N70-23811# Fraunhofer Institut, Freiburg (West Germany).

CHARACTERISTIC PARAMETERS OF THE ROBERTSON TEST AND THEIR RELATIONSHIPS WITH NOTCH IMPACT-BENDING TESTS [KENNZEICHNENDE GROESSEN DES ROBERTSONTESTES UND IHRE BEZIEHUNGEN ZUM KERBUSCHLAGBIEGEVERSUCH]

Dietmar Bechert 1969 163 p refs In GERMAN

(Rept-1-69) Avail: CFSTI

The fracture behavior of structural steels was investigated by means of the Robertson test and notch impact tests. This behavior was characterized by four temperatures, which are defined in detail. The fracture velocity, the fracture inhibition prestress limit, and the fracture inhibition temperature were measured, and the relationship between mechanical twinning and deformation lines was investigated. It appears that the Robertson test cannot be replaced by other less expensive tests.

ESRD

N70-23890# Army Materials and Mechanics Research Center, Watertown, Mass.

FATIGUE-CRACK PROPAGATION IN ARMOR STEELS Technical Report

Albert A. Anctil and Eric B. Kula Nov. 1969 20 p refs

(Contract DA-1-T-062105-A-328)

(AD-699348; AMMRC-TR-69-25) Avail: CFSTI

Fatigue-crack propagation in high- and dual-hardness armor steels was studied at various fatiguing stresses and testing temperatures using a fracture mechanics analysis of the data. The armor steels tested were: (1) a high-hardness XAR-30 steel; (2) an ausformed cross-rolled H11 and X27 steel composite; and (3) a dual-hardness composite of Ni-Cr-Mo steels with 0.34 and 0.51 carbon. Crack-growth rates increased directly with increasing fatiguing stress level and decreasing testing temperatures. The fatigue-crack growth rate d2a/dN versus the change in stress intensity factor delta K followed an empirical relationship d2a/dN = C delta K to the m power for the high-hardness and thin-section dual-hardness Ni-Cr-Mo composite steels. The crack-growth rate exponent m was 5.0 in the XAR-30 and 2.3 in the Ni-Cr-Mo steel. Crack-growth rates were generally higher in both the XAR-30 and Ni-Cr-Mo dual-hardness steels than in 4340 steel at the same strength level. The fracture mode for these steels was predominantly plane strain. The low fracture toughness component of the composite steel failed first and thereby caused rapid fatigue-crack growth acceleration and fast fracture in the remaining component.

Author (TAB)

N70-23902# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ENERGY CHARACTERISTICS OF DELAYED RUPTURE OF TITANIUM ALLOYS

V. N. Meshcheryakov et al 30 Sep. 1969 24 p refs Transl. into ENGLISH Fiz. i Khim. Obrabotki Materialov (USSR), no. 4, 1967 p 108–118

(AD-699250; FTD-MT-24-211-69) Avail: CFSTI CSCL 11/6

The calculation of the activation energy in the process of delayed rupture of high-strength titanium alloys showed the validity of using the hypothesis about the essential role of vacancies in the formation of nuclei of cracks along grain boundaries previously based on the analysis of the process of delayed rupture of work hardened steel. In the case of plastic alloys of titanium the calculated data of activation energy according to curves of temporary dependence of strength indicate the development of strain aging in the process of testing in a specific interval of stresses low in value. The calculation of the activation energy of these alloys according to the rate of steady-state creep gives smaller values of energy than according to temporary dependences of strength. This is caused by the fact that during the accretion of deformation during creep all three stages of creep contribute in the process of testing for delayed rupture. The calculation of activation energy of plastic alloys of titanium, alloyed with 2.5 percent zirconium indicate that

strain aging in those alloys is suppressed at an oxygen content up to 0.25 percent and develop noticeably at an oxygen content of 0.42 percent. Author (TAB)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N70-22542# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center.
SILICON DATA SHEETS
Meta Neuberger and Sheldon J. Welles Oct. 1969 270 p refs
(Contract F33615-68-C-1225)
(AD-698342; EPIC-DS-162) Avail: CFSTI CSCL 20/12

The data sheets present a compilation of a wide range of electronic properties for silicon. The energy band structure is thoroughly reviewed and included are effective mass, solubility and diffusion with resulting values for energy levels and the dielectric constant. Electrical properties include mobility, resistivity, lifetime and piezoresistance. The various thermal and magnetic properties such as Debye temperature, thermal conductivity, phonon dispersion and the Seebeck, Nernst and Ettingshausen coefficients are reported. The g-factor, magnetic susceptibility and electron spin resonance are given. The optical properties, absorption, refractive index and reflectivity are reported as well as both photon and electron emission, including work function data. Each property is compiled over the widest possible range of parameters, including bulk and film samples. A data table which includes a wide range of mechanical, physical and thermal properties is included as well as a summary of crystal structure and phase transitions. There is also a general discussion of silicon technology. Author (TAB)

N70-22710# Catholic Univ. of America, Washington, D.C. Vitreous State Lab.
HEAT CAPACITIES OF GLASSY AND LIQUID As2S3 and As2Se3
U. E. Schnaus, C. T. Moynihan, R. W. Gammon, and P. B. Macedo Dec. 1969 19 p refs
(Contract N00014-68-A-0506-0002)
(AD-698842; TR-6) Avail: CFSTI CSCL 7/4

Heat capacities of glassy and liquid As2 S3 and As2 Se3 have been determined over the respective temperature intervals 180-650 K and 180-620 K. The heat capacity data indicate an effective Debye Temperature difference of about 100 K between the sulfide and selenide glasses, which is approximately the difference expected on the basis of the atomic mass differences of the two compounds. As2 Se3 appears to be the first published example of a glass which exhibits the limiting Dulong and Petit heat capacity over a sizeable temperature interval before the onset of the glass transition. The lack of correspondence between T g and Debye temperature is of considerable importance with regard to the production of IR-transmitting chalcogenide glasses, since it indicates that one may optimize IR-transmission characteristics by using high atomic mass components without lowering drastically the upper use temperature, i.e., the glass transition temperature. Author (TAB)

N70-22988# Triplex Safety Glass Co., Ltd., London (England).
THE REPEATABILITY OF STRENGTH OF TOUGHENED CLEAR WHITE PLATE AND TWIN GROUND PLATE GLASS
D. L. A. Hand and W. G. Roberts Min. of Technol. Sep. 1969 25 p refs
(Contract KS/1/0330/C.B.43(a)1)
(D-MAT-163) Avail: CFSTI

A total of 1250 glasses, each 12 in. square were toughened and burst under hydraulic pressure, to investigate the repeatability of strength of toughened Clear White Plate and Twin Ground Plate glass. A further 500 glasses were used in setting up and maintaining furnace conditions while the 1250 glasses were toughened at different times in 50 batches of 25 glasses each. Modulus of rupture determinations were carried out on each glass and the coefficients of variation within and between batches was calculated. The average coefficient of variation within batches was 7.5 percent for Clear White Plate and 9 percent for Twin Ground Plate, however the variation in mean moduli of rupture between batches was significantly greater for Clear White Plate. The mean moduli of rupture for both 1/4 in. and 1/2 in. Clear White Plate were low compared with the Twin Ground Plate results. Author (ESRO)

N70-23000*# Scripta Technica, Inc., Washington, D.C.
INVESTIGATION OF THE EFFECT OF IONIZING RADIATION ON GLASS ACTIVATED BY TRANSITION METALS [ISSLEDOVANIYE DEYSTVIYA IONIZIRUYUSHCHEY RADIATSII NA STEKLA, AKTIVIROVANNYYE PEREKHODNYMI METALLAMI]
D. G. Galimov et al NASA Mar. 1970 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorgan. Materialy (Moscow), v. 5, Aug. 1969 p 1386-1391
(Contract NASw-1694)
(NASA-TT-F-12857) Avail: CFSTI CSCL 11B

Radiospectrometric measurements of the effective cross sections of charge carrier capture by ions at 77 and 300 deg K in gamma-irradiated specimens of P-Al-Si glass with additions of Mn, Fe, Cr, V, Ti, Mo, W, Nb, Zr, or Ce oxides. The effectiveness of these ions in improving the radiation stability of this glass is evaluated quantitatively and attempt to identify the electron signal with g equal to 2.001 leads to the assumption that the electrons captured in the 3d orbital of silicon in the (SiO4) tetrahedron are responsible for the signal. Author

N70-23012# Royal Aircraft Establishment, Famborough (England).
PHYSICO-MECHANICAL PROPERTIES OF POLYMERS, ENSURING A HIGH RESISTANCE TO WEAR IN FRICTIONAL CONTACTS [FIZIKO-MEKHANICHESKIE SVOISTVA POLIMEROV, OBESPECHIVAYUSHIE VYSOKUYU IZNOSOTOIKOST' UZLOV TRENIYA]
I. V. Kragel'skii et al Oct. 1969 21 p refs Transl. into ENGLISH from Russian Publ.
(RAE-LIB-TRANS-1416) Avail: CFSTI

A review is given of the various types of wear which can occur with rubbers and plastics, and the relationships of wear to the conditions of sliding and material properties. Author

N70-23048# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PETROLEUM PRODUCTS, PROPERTIES, QUALITY, APPLICATION, PART 3
B. V. Losikov 22 Aug. 1969 200 p refs Transl. into ENGLISH from the Russian Report
(AD-698547; FTD-HT-23-347-68-Pt-3) Avail: CFSTI CSCL 11/8

The document contains Chapters 7-10 of a Russian handbook of petroleum products. These chapters discuss drive-train oils, lubricating oils for aviation gas-turbine engines, industrial oils, and insulating oils. TAB

N70-23049# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PETROLEUM PRODUCTS, PROPERTIES, QUALITY, APPLICATION, PART 4
B. V. Losikov 22 Aug. 1969 237 p refs Transl. into ENGLISH from the Russian Report
(AD-698548; FTD-HT-23-347-68-Pt-4) Avail: CFSTI CSCL 11/8

The document contains Chapters 11 and 12 of a Russian handbook of petroleum products. These chapters discuss oil additives (viscosity, antioxidants, anticorrosion, detergents, antifoams) and lubricants. TAB

N70-23050# National Center for Atmospheric Research, Boulder, Colo.
EFFECTS OF THERMAL CYCLING ON BIAXIALLY STRESSED BALLOON FILMS
Jul. 1969 59 p refs Prepared in cooperation with Hauser Research and Engineering Co.
(PB-186492; NCAR-TN-41) Avail: CFSTI CSCL 01C

The results of an examination of the biaxial strength properties of balloon films are presented. Balloons are known to experimence large in-flight temperature variations. The report investigates the effect of a prior history of biaxial loading of balloon films in one temperature environment (+23 or −80 deg C) on ultimate properties in the other environment. Materials were chosen in light of prior familiarity with their uniaxial, biaxial, and cold toughness properties and with their flight performance records. (USGRDR)

N70-23072 Alfred Univ., N.Y. Coll. of Ceramics.
THE ELASTIC PROPERTIES AND THERMAL EXPANSION OF BODIES IN THE Cr2O3-Mg-O SYSTEM
Robert Mantell Williams (Ph.D. Thesis) 1967 111 p
Avail: Univ Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-3298

The elastic moduli of sintered bodies in the Cr2O3-MgO system were determined as a function of temperature using the Forster resonance technique. The coefficients of thermal expansion were also measured. None of the theoretical expressions relating composition and elastic moduli (or expansion) were found applicable to the system studied. This was attributed to structural imperfections: poor bonding of the spinel within the Cr2O3-MgO-Cr2O3 section of the system and to microcracking caused by differences of thermal expansion in the MgO-Cr2O3-MgO section of the system. Since the theoretical relationships require completely defined boundary conditions, their application to multiphase bodies is limited. Within any one composition the room temperature elastic moduli showed a linear relationship with porosity. The dependence of thermal expansion upon composition approached linearity. Dissert. Abstr.

N70-23111# New York State Dept. of Transportation, Albany.
A STUDY OF NORMAL LEAD SILICO CHROMATE PIGMENT IN YELLOW TRAFFIC ZONE PAINTS
J. G. Fred Hiss, Jr. and David R. Brewster Jul. 1969 34 p Prepared in cooperation with Bur. of Public Roads
(PB-186485; RR-69-13) Avail: CFSTI CSCL 11C

The report presents the performance of both modified alkyd and modified alkyd-chlorinated rubber type yellow traffic marking paints which utilize normal lead silico chromate in lieu of the more commonly used medium yellow in the pigment formulations. Field and laboratory tests were conducted on paint samples. Two formulations were developed, based upon a normal lead silico chromate pigment, in which the color was acceptable and the performance similar to that being received from the current standard yellow paint. In addition, the use of a yellow, normal lead silico chromate paint may result in a reduced paint cost. USGRDR

N70-23334# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSICO-MECHANICAL METHODS OF TESTING CHEMICAL FIBER FILAMENTS AND FILMS
N. V. Demina et al 8 Aug. 1969 376 p refs Transl. into ENGLISH of the book "Metody Fizikomekhanicheskikh Ispytaniy Khimicheskikh Volokon, Nitey i Plenok" Moscow, Izd. Legkaya Industriya, 1964 p 1–352
(AD-698545; FTD-HT-23-521-67) Avail: CFSTI CSCL 11/5

Instruments and procedures used in the physicochemical testing of chemical fibers are described. A description of the test methods for staple fibers, filament yarn, and cellophane is given. Author (TAB)

N70-23360# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE QUESTION OF THE PROTECTIVE ACTIVITY OF OXIDATION RESISTANT COATINGS
L. D. Svirskii et al 17 Jul. 1969 10 p refs Transl. into ENGLISH from Tr. Inst. Khim.- Tekhnol. Dnepropetrovsk (USSR), no. 8, 1967 p 146–148
(AD-698533; FTD-HT-23-419-69) Avail: CFSTI CSCL 11/3

Discussed are the compositions of enamel oxidation resistant coatings for steel which contain alkaline earth oxides and thus fire at low temperatures. TAB

N70-23379# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
LOAD-ABSORPTION BY A FILAMENT IN A FIBER-REINFORCED MATERIAL Research Report
Eli Sternberg and Rokuro Muki Oct. 1969 35 p refs
(Contract Nonr-220(58))
(AD-698299; TR-20) Avail: CFSTI CSCL 11/4

This investigation deals with the static transfer of load to a single semi-infinite elastic fiber that is fully immersed in, and continuously bonded to, an all-around infinite elastic matrix of distinct mechanical properties. The matrix, at infinity, is assumed to be in a state of uniform uni-axial tension parallel to the embedded fiber. By means of an approximative scheme - developed and tested earlier in connection with a related simpler three-dimensional load-transfer problem - the characterization of the desired fiber-force is reduced to an integral equation of Fredholm's second kind. The far-field asymptotic behavior of the force absorbed by the filament is extracted from, and used to facilitate the numerical solution of, the governing integral equation. In addition, the character of the singularity in the bond-force density at the end of the fiber is established. Extensive quantitative results, showing the distribution of the fiber-force for various choices of the relevant physical parameters, are presented. Author (TAB)

N70-23446# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
CORROSION EVALUATION OF SHIELDING MATERIALS FOR DIRECT BURIAL TELEPHONE CABLES Progress Report
Gerald A. Lohsl and Melvin Romanoff 1969 41 p refs Presented at 18th Intern. Wire and Cable Symp., Atlantic City, 3–5 Dec. 1969 Submitted for publication
(AD-698617) Avail: CFSTI CSCL 17/2

Corrosion data on the performance of bare and plastic coated metals intended for use as cable shields in direct burial telephone cable is presented. The metals were placed in buried cable specimens which had their outer jackets damaged to simulate actual usage in the field. These cable specimens were then exposed for one year in six different underground environments which are representative of practically all soils within the United States. Author (TAB)

N70-23477# Du Pont de Nemours (E.I.) and Co., Wilmington, Del. Elastomer Chemicals Dept.
ETHYLENE PROPYLENE TERPOLYMER IN WIRE AND CABLE CONSTRUCTIONS
D. R. Luh Dec. 1969 20 p ref Presented at 18th Intern. Wire and Cable Symp., Atlantic City, 3–5 Dec. 1969
(AD-698715; Contrib-263) Avail: CFSTI CSCL 9/1

The paper deals with applications in the wire and cable industry where ethylene propylene terpolymers are providing a basis for flexible thermosetting insulations, jackets and integral

coverings, as well as for molded electrical components which offer a new order of performance. Author (TAB)

N70-23478# Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
HIGH BRIGHTNESS CRT PHOSPHOR DEVELOPMENT
A. E. Oberg 26 Nov. 1969 26 p
(Contract N00024-69-C-5364)
(AD-698309) Avail: CFSTI CSCL 9/1

The JEDEC registered phosphors P24 and P36 and the proprietary phosphor PX51 were compared for light output, decay time, and spectral response in the 4700A and 5500A range. Results are noted. TAB

N70-23479# IIT Research Inst., Chicago, Ill.
FRACTURE STUDIES IN GLASSY POLYMERS Final Report, 8 May 1967 – 8 Nov. 1968
Lawrence J. Broutman and Takao Kobayashi Aug. 1969 179 p refs
(Contract DAAG17-67-C-0133)
(AD-698567; AMMRC-CR-69-13) Avail: CFSTI CSCL 11/9

The objective of the program was to study the fracture of glassy organic polymers so that a better understanding between the polymer structure and fracture characteristics could be gained. Of particular interest was the determination of the fracture surface work or energy required to initiate and propagate a crack through the polymer. Polymer structural features which were studied include (1) chain stiffness, conformation and molar cohesion, (2) degree of crosslinking, (3) tacticity and degree of crystallinity, (4) molecular weight and molecular weight distribution, and (5) polymer molecular orientation. Author (TAB)

N70-23487# Archer Products, Inc., Winston-Salem, N.C.
PROPERTIES OF EXTRUSION RESINS USED IN CONJUNCTION WITH ALUMINUM CABLE SHIELDING
S. I. Arnold 1969 9 p refs Presented at the 18th Intern. Wire Cable Symp., Atlantic City, 3 – 5 Dec. 1969
(AD-698600) Avail: CFSTI CSCL 9/1

The report presents the results of a program to develop a process for manufacturing plastic clad cable shielding. TAB

N70-23536# Bell Telephone Labs., Inc., Murray Hill, N.J.
CHARACTERIZATION OF FILLER AND INSULATION IN WATERPROOF CABLE
J. P. Mc Cann, R. Sabia, and B. Wargotz 1970 33 p refs Presented at 18th Intern. Wire and Cable Symp., Atlantic City, 3 – 5 Dec. 1969
(AD-698654) Avail: CFSTI CSCL 17/2

Communication cable technology has been revolutionized by the development of waterproof cable designs. Specification of the filler, insulation, and sheath depends on the solution to many interesting questions. Answers to those questions required studies on the composition of the filler, interaction of materials, and long-term performance. Data on the petrolatum/polyethylene filler are presented, from which compositions of desired characteristics can be formulated. Mechanical performance of insulation and sheath materials in contact with petrolatum is discussed to justify the use of polypropylene for the insulation and modified polyethylene for the sheath. Finally, data on the long-term performance of the petrolatum-exposed insulation in an oxidative environment are presented. Author (TAB)

N70-23557# North Carolina State Univ., Raleigh.
STUDIES OF HIGH STRENGH POLYPROPYLENE: THE ORIGINS OF DYNAMIC RESPONSES Technical Report
T. Weller George Nov. 1969 35 p refs
(Contract N00014-68-A-0187)
(AD-698278; TR-69-9) Avail: CFSTI CSCL 11/5

The report outlines research undertaken to identify a set of microstructure elements present in strong organic fiber in which reside the primary means of response on the part of the material to dynamic load application. The elements involve two microfibrillar concepts, viz., a set of nearly parallel structures and a set of finer transition fibrils which bridge between the former under conditions of nearly axial alignment. Scanning electron micrographs of the structural features are reported. The transition fibril is reported in one experimental setting to exhibit evidences of a labile chemical structure under exposure to ultraviolet radiation in the presence of halogens (room temperature). A second principal contribution involves the statistical theory of the strength of a parallel array of fiber. The model envisions individual filaments possessing strength properties distributed along the length in accordance with the conventional weakest-link hypothesis. A set of moment inequalities has been obtained which shows the mean bundle strength per element in the absence of interaction between the constituent elements to be progressively degraded as the bundle size increases. Author (TAB)

N70-23559# Southwest Research Inst., San Antonio, Tex.
INVESTIGATION OF LIGHTWEIGHT SULFUR FOAM FOR USE IN FIELD APPLICATIONS Technical Report, 9 Aug. 1967 – 9 Nov. 1968
John M. Dale and Allen C. Ludwig Oct. 1969 22 p refs
(Contract DAAG-23-68-C-0001)
(AD-698461; CRREL-TR-227) Avail: CFSTI CSCL 13/3

Previous studies indicated that lightweight sulfur foams had thermal insulating characteristics and mechanical properties which were sufficiently attractive that they could be considered for a number of structural applications. The subject study was undertaken in order to determine if the process for preparing sulfur foam could be scaled up from small laboratory-size equipment, producing 4 lb of foam per batch, to large conventional pressure-heated equipment capable of producing 500 lb of foam per batch. This was accomplished, and large quantities of sulfur foam were prepared and tested for such applications as subbases for roadways, as foam core panels, and for foamed-in-place structures. The sulfur foams appear particularly attractive for the subbase applications and foam core panels. Further investigations are required for the foamed-in-place structures because of the initial creep characteristics associated with the sulfur foams, first identified during the course of this study. Author (TAB)

N70-23589# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeugbau.
INVESTIGATIONS OF THE MICROPROPERTIES AND MECHANICAL PROPERTIES OF UNIDIRECTIONALLY BORON FIBER REINFORCED PLASTICS [UNTERSUCHUNGEN DES MIKROVERHALTENS UND DER MECHANISCHEN EIGENSCHAFTEN UNIDIREKTIONAL BORFADENVERSTAERKTER KUNSTSTOFFE]
Jochen Mueller May 1969 44 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-29) Avail: CFSTI

The behavior under load of single boron filaments imbedded in a resin matrix were studied by means of elastic investigations and other tests were carried out to determine the wetting capability of different resins on boron filaments and the single filament resin pull-out strength. Longitudinal strength and Young's moduli were determined in tension, compression and bending. Transverse tensile strength and Young's modulus as well as the shear modulus and interlaminar shear strength were also measured. The influence of the ratio of the support width to specimen thickness in the bending test with three-point loading was also investigated. Author (ESRO)

N70-23575# Royal Aircraft Establishment, Farnborough (England).
THE EFFECT OF STRETCH DURING THE WET-SPINNING OF POLYACRYLONITRILE PRECURSOR FIBRES ON THE MECHANICAL PROPERTIES OF THE RESULTANT CARBON FIBRES
R. Moreton Jun. 1969 14 p refs
(RAE-TR-69114) Copyright. Avail: CFSTI

Fibres of polyacrylonitrile were prepared by wet-spinning from a sodium thiocyanate solution and the amount of stretching in steam was varied between ×5 and ×13. These fibres were converted to carbon fibres by preoxidizing in air at 220 C, followed by carbonization to 1000 C in hydrogen and heat treatment to 2500 C in argon. The results of mechanical tests showed that the tensile strengths and the Young's moduli of the carbon fibres increased with the amount of stretch thus reflecting a similar trend that had been present originally in the polymer fibres. The carbon fibres produced from the polyacrylonitrile fibres that had been steam-stretched ×13 had an average Young's modulus of 50 million lb/sq in and an average tensile strength of 177,000 lb/sq in after being heat-treated to 2500 C. Author (ESRO)

N70-23597# ITT Surprenant, Clinton, Mass.
CROSS-LINKED PVC WIRE INSULATION SYSTEMS
W. A. Nicoll 1969 17 p Presented at the Intern. Wire and Cable Symp. (18th), Atlantic City, N.J., 3–5 Dec. 1969
(AD-698604) Avail: CFSTI CSCL 9/1

A key performance characteristic of PVC insulation, deformation at high temperature, was markedly altered by irradiation cross-linking to extend the useful reliable upper service temperature limit of PVC systems. Many useful product innovations resulted. Insulated wire and cable products are available in a variety of types for various applications and can be tailored to meet stringent combinations of design parameters at a cost that is competitive with many other engineered solutions. Author (TAB)

N70-23615# Raychem Corp., Menlo Park, Calif.
A NEW EXTRUDED ALKANE-IMIDE WIRE
V. L. Lanza and R. M. Halperin Dec. 1969 25 p Presented at the 18th Intern. Wire and Cable Symp., Atlantic City, 3–5 Dec. 1969
(AD-698716) Avail: CFSTI CSCL 9/1

A new sandwich construction insulation system consisting completely of polyimides was developed to meet the need for smaller and lighter weight wires. This required the synthesis of a new alkane-imide polymer. This polymer, in combination with other polyimides, yielded a wire construction which has an overall combination of useful properties not found in other wires. In addition to its excellent physical-mechanical, electrical and handling characteristics, it can be fabricated on conventional wire processing equipment. Author (TAB)

N70-23643# Du Pont de Nemours (E.I.) and Co., Wilmington, Del. Plastics Dept.
PROCESSING CABLE JACKETS OF POLYETHYLENE
F. H. Skewis 1969 35 p refs Presented at 18th Intern. Wire and Cable Symp., Atlantic City, 3-5 Dec. 1969
(AD-698608) Avail: CFSTI CSCL 11/9

A study of the effect of die design on properties of jackets of low density polyethylene is reported. The procedure used in this study is easily applied and economically practical. A meaningful and rapid test has been used to determine residual stress in cable jackets produced under a variety of conditions. Author (TAB)

N70-23745# National Bureau of Standards, Washington, D.C. Office of Flammable Fabrics.
BIBLIOGRAPHIES ON FABRIC FLAMMABILITY. PART 1: WEARING APPAREL. PART 2: FABRICS USED ON BEDS. PART 3: CARPETS AND RUGS
Sidney H. Greenfeld, Elizabeth R. Warner, and Hilda W. Reinhart Feb. 1970 35 p refs
(NBS-TN-498) Avail: SOD $0.40

In order to facilitate research and assist in the development of new standards and test methods in flammable fabrics, a series of bibliographies is being prepared by the NBS Office of Flammable Fabrics. The first three, on wearing apparel, bed fabrics and carpets and rugs, are included in this Technical Note. Author

N70-23834# Fraunhofer Institut, Freiburg (West Germany).
CRACK PROPAGATION WITH SUPERSONIC VELOCITY IN POTASSIUM CHLORIDE SINGLE CRYSTALS [BRUCHAUSBREITUNG MIT UEBERSCHALLGESCHWINDIGKEIT IN KCL-EINKRISTALLEN]
S. Winkler, D. R. Curran, and D. A. Shockey Oct. 1969 27 p refs In GERMAN
(Rept-8/69) Avail: CFSTI

Crack velocities in single potassium chloride crystals of an order of magnitude higher than the highest wave velocity were observed. From the magnitude of the cracks on photographic recordings, made approximately 80 nanoseconds after the start of the laser pulse, it was found that the mean crack propagation velocities were of the order of 10 to 100 km/sec. A theoretical model was developed to account for these experimental results. ESRO

N70-23851# Bureau of Mines, College Park, Md. Metallurgy Research Center.
ANODE MATERIALS FOR ALUMINA REACTIONS: EVALUATION OF LIGNITE AS A CARBON SOURCE
V. A. Cammarota, Jr. and David Schlain Apr. 1970 49 p refs
(BM-RI-7370) Avail: Issuing Activity

The effects of anode production variables, such as aggregate coke sizes, pitch binder content, and baking cycle, were investigated. A small alumina reduction cell proved effective in evaluating anodes prepared from commercial materials and from lignite coke and pitch. Compressive strength was found to be the physical property most significantly influenced, but it did not appear to affect anode consumption. Specific carbon consumption, that is, the ratio of carbon in the anodic gas to carbon theoretically oxidized at the anode, was used as an index of anode consumption. It was found that an anode made with lignite coke and commercial pitch was very low in consumption; however, anodes made completely from lignite but by a different fabrication method showed high consumption and anode deterioration. Microscopic examination of anodes after electrolysis showed evidence of higher consumption at low current densities, and was useful in judging overall anode quality. Based on the physical properties of the anodes and their consumption during electrolysis, lignite can be a suitable material for anodes, provided the proper fabrication conditions are used. Author

N70-23877# Philips Zentrallaboratorium G.m.b.H., Aachen (West Germany).
INVESTIGATION OF THE OPTICAL AND THERMAL BEHAVIOR OF SURFACE COATINGS FOR THE HELIOS SPACE PROBES [UNTERSUCHUNG DES OPTISCH UND WAERMETECHNISCHEN VERHALTENS VON OBERFLAECHENBESCHICHTUNGEN FUER DIE HELIOS-SONDE]
H. Hoerster 1969 22 p In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969 Sponsored by Deut. Ges. fuer Weltraumforsch. Prepared jointly with Messerschmitt-Boelkow
Avail: CFSTI

Investigations on surface coatings were made as part of the experimental work for the Helios solar space probe. Special attention was given to the manufacture of the coatings, optical and

thermal measurements, long-duration tests under simulated space conditions and ultraviolet degradation and the results are surveyed. The coatings investigated were white paint and optical solar reflectors comprising mirrors with dielectrics transparent to sunlight.
ESRO

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N70-22509# California Univ., Los Angeles. Dept. of System Sciences.
ON A PRIORI ERROR ESTIMATES OF SOME IDENTIFICATION METHODS
M. Aoki and P. C. Yue 9 Dec. 1969 31 p refs
(Grant AF-AFOSR-1328-67)
(AD-698827; AFOSR-69-3043TR) Avail: CFSTI CSCL 12/1

The paper examines in detail the estimation errors of two algorithms proposed by Koopmans and Levin for identifying linear systems described by an nth order scalar difference equation. Necessary and sufficient conditions are established for the strong consistency of the estimates that these algorithms generate. A priori error bounds on estimation error are obtained to provide a quantitative basis for comparing these algorithms in relation to the maximum likelihood estimates. Computational results are also presented to supplement the theoretical discussions.
Author (TAB)

N70-22526 National Lending Library for Science and Technology, Boston Spa (England).
SOLUTION OF A GENERAL PROBLEM IN THE THEORY OF ELASTICITY FOR CERTAIN BOUNDARY CONDITIONS
I. A. V. Gorely 21 Nov. 1969 5 p ref Transl. into ENGLISH from Dinam. i. Prochnost Mashin. Resp. Mezhved. Nauchno. Tekhn. (USSR), pt. 3, 1966 p 56–58
(NLL-CE-Trans-5027-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The case of the mixed boundary conditions is considered. If these conditions are such that on the surface of the body, the divergence theta and the p,q,r components of the curl of the displacement vector can be distinguished, the solution to the problem can be divided into two stages. The first stage is the determination of the first integral of the fundamental equations of the theory of elasticity. The second stage is the determination of the displacements. At each stage an independent boundary value problem is solved for certain differential equations with actual boundary conditions.
Author

N70-22530 National Lending Library for Science and Technology, Boston Spa (England).
ON RINGS EACH SUBRING OF WHICH IS A DIRECT SUMMAND OF THE RING [OKOLTSAKH, KAZHDOE PODKOLTSO KOTORYKH YAVLYAETSYA PRYAMYM SLAGAEMYM KOLTSA]
F. Sas Dec. 1969 9 p refs Transl. into ENGLISH from Mat. Sb. (Moscow), v. 40, no. 82 (2), 1956 p 269–272
(NLL-RTS-5419) Avail: Natl. Lending Library, Boston Spa, Engl.: 10s or 1 NLL photocopy coupon

Considered are all rings each subring of which is a direct summand of the ring. A ring R is said to be a ring with property P if each subring S of R is a direct summand of R. A simple description is given of rings with property P by a theorem.
G.G.

N70-22547# Wisconsin Univ., Madison. Dept. of Computer Sciences.
CONVERGENCE OF A DISCRETIZATION FOR CONSTRAINED SPLINE FUNCTION PROBLEMS Technical Report
James W. Daniel Oct. 1969 33 p refs
(Contract N00014-67-A-0128-0004)
(AD-697899; TR-76) Avail: CFSTI CSCL 12/1

Two discretizations are analyzed for computing general spline functions satisfying discrete and continuous inequality constraints; convergence is proved.
Author (TAB)

N70-22571*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIRECT CANONICAL TRANSFORMATIONS
David P. Stern Mar. 1970 19 p refs Revised
(NASA-TM-X-63848; Rept-X-641-69-516) Avail: CFSTI CSCL 12A

Some of the perturbation methods in classical Hamiltonian mechanics lead to near-identity transformations of the variables, with the new variables explicitely given as functions of the old ones. Two methods are used for identifying and characterizing the subclass of all such transformations which are also canonical; one approach is related to the conventional method of generating canonical transformations, while the other one uses the properties of Poisson brackets and is related to an operator method of Lie.
Author

N70-22584 Carnegie-Mellon Univ., Pittsburgh, Pa.
SOME TECHNIQUES FOR ALGORITHM OPTIMIZATION WITH APPLICATION TO MATRIX ARITHMETIC EXPRESSIONS
Robert Alan Wagner (Ph.D. Thesis) 1968 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-7907

A technique was developed for producing new algorithms equivalent to old algorithms and thus expanding program technologies. A second technique is described which reduces the effort required by certain exhaustive searches over well-structured search spaces. These techniques are applied to the production of algorithms for evaluating matrix arithmetic expressions (MAE). A method is described for producing, for any MAE, an algorithm for its evaluation which requires fewest arrays for holding N by N matrices, while not requiring more execution time than the standard MAE evaluation algorithm. Although the algorithm-production method used is basically an exhaustive-search over a large space of program alternatives for each subexpression of the given MAE, the effort this method requires grows only linearly with the number of operators in the given expression.
Dissert. Abstr.

N70-22587 California Univ., Los Angeles.
ON TAME SUBSETS OF SPHERES IN EUCLIDEAN SPACES
Ian Michael Ferris (Ph.D. Thesis) 1968 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-5306

On the basis that every 2-sphere in R(3) contains a tame simple closed curve, similar theorems for S(k) in R(n) are proven by imbedding and approximation methods.
Dissert. Abstr.

N70-22600 Cornell Univ., Ithaca, N.Y.
FREDHOLM MANIFOLDS AND COHOMOLOGY
Kalyan Kumar Mukherjea (Ph.D. Thesis) 1968 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-5028

Fredholm manifolds are Banach manifolds whose tangent bundles are reducible to GC(E). In this work are studied homological

properties of Fredholm manifolds and maps. The first chapter recollects some standard material on Poicare duality of finite dimensional topological manifolds. In the second, it is shown that as far as homotopy type a C infinity Fredholm manifold is an increasing union of finite dimensional closed submanifolds. These submanifolds. These submanifolds - collectively known as a filtration - also determine the orientability of the Fredholm manifold. The filtration of a Fredholm manifold and duality in finite-dimensional manifolds is then used to obtain dimensional cohomology groups for a Fredholm manifold X and a closed subset A, thereof. These groups satisfy Poincare and Alexander-Pontryagin duality. Dissert. Abstr.

N70-22604 Stanford Univ., Calif.
POSITIVITY CONDITIONS IN ANALYTIC FUNCTION THEORY
Alan Carleton Hindmarsh (Ph.D. Thesis) 1968 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-8195

In classical analytic function theory, there are a number of situations in which a property of interest (e.g., analytically, univalence, extendability) of a function can be characterized by the non-negative definiteness of some Hermitian kernel associated with the function. The main examples are the Grunsky inequalities (which characterize the univalence of certain analytic functions), the Pick conditions (which hold for analytic half-plane functions) and Loewner's theorem (which deals with analytic extendability from an interval). In these and other examples, further insight is gained by making a *local interpretation* of the positivity condition in question, i.e., by relating the condition to pointwide inequalities on the derivatives of the kernel (and hence the function) involved. The process of local interpretation can also be carried out for general kernels. Typically, a given positivity condition on a kernel K leads to pointwise differential inequalities for K. Conversely, these inequalities often imply the original positivity condition, at least locally. To illustrate, considered is a kernel K(x,y) defined for x and y in a real interval I. Dissert. Abstr.

N70-22606# Sandia Corp., Albuquerque, N.Mex.
BES: A ROUTINE FOR THE EVALUATION OF CYLINDRICAL BESSEL FUNCTIONS
R. D. Halbgewachs Oct. 1969 60 p refs
(PB-187226; SC-M-69-336) Avail: CFSTI CSCL 12A

The BES subroutine evaluates the Bessel functions J (sub n) (x), Y (sub n) (x), I (sub n) (x), and K (sub n) (x) for real arguments and integer orders. The functions J (sub n) (x) and I (sub n) (x) may have positive or negative arguments, while the functions Y (sub n) (x) and K (sub n) (x) are restricted to positive arguments. The order for each of the functions may be positive or negative. In addition, the Hankel functions may be determined through the use of this routine. Author (USGRDR)

N70-22611# Wisconsin Univ., Madison. Dept. of Statistics.
FURTHER CONSIDERATION OF THE DISTRIBUTION OF THE MULTIPLE CORRELATION COEFFICIENT Technical Report
John Gurland and Roy Milton Aug. 1969 19 p refs
(Grant NSF GP-7705)
(PB-187294; TR-215) Avail: CFSTI CSCL 12A

A general class of series expansions for the non-null distribution of the multiple correlation coefficient is presented which contains, as special cases, the three expansions obtained by one of the authors (Gurland (1968)). The rate of convergence is investigated, and the closeness of an approximation to the true distribution is indicated. Author (USGRDR)

N70-22623# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
OPTIMAL DYNAMIC OPERATING POLICIES FOR A SERVICE FACILITY Technical Report
James S. Kakalik Oct. 1969 154 p refs
(Contract NONR-3963(06))
(AD-698797; TR-47) Avail: CFSTI CSCL 12/2

The dynamic control of service facilities is studied with the goal of determining optimal policies for the acceptance or rejection of arriving customers, for the control of the rate at which customers are serviced, and for the order in which customers of different types are served. Optimal steady state policies are found for several models of service facilities. The technique utilized is to hypothesize the form of the optimal control as a function of the state of the system and then verify optimality using Markovian and Semi-Markovian Decision Analysis. Author (TAB)

N70-22625# Stanford Univ., Calif. Dept. of Computer Science.
THE MAXIMUM AND MINIMUM OF A POSITIVE DEFINITE QUADRATIC POLYNOMIAL ON A SPHERE ARE CONVEX FUNCTIONS OF THE RADIUS Technical Report
George E. Forsythe Jul. 1969 13 p refs
(Contract N00014-67-A-0112-0029)
(AD-698800; CS-144) Avail: CFSTI CSCL 12/1

It is proved that in Euclidean n-space the maximum M(rho) and minimum M(rho) of a fixed positive definite quadratic polynomial Q on spheres with fixed center are both convex functions of the radius rho of the sphere. Author (TAB)

N70-22626# Stanford Univ., Calif. Dept. of Computer Science.
FIXED POINTS OF ANALYTIC FUNCTIONS Technical Report
Peter Henrici Jul. 1969 11 p refs Sponsored in part by NSF
(Contract N00014-67-A-0112-0029)
(AD-698801; CS-137) Avail: CFSTI CSCL 12/1

A continuous mapping of a simply connected, closed, bounded set of the Euclidean plane into itself is known to have at least one fixed point. It is shown that the usual condition for the fixed point to be unique, and for convergence of the iteration sequence to the fixed point, can be relaxed if the mapping is defined by an analytic function of a complex variable. Author (TAB)

N70-22635 Purdue Univ., Lafayette, Ind.
BANACH LIMITS AND RELATED TOPICS
Euline Irwin Green (Ph.D. Thesis) 1968 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-7448

The content falls into two parts. The first is centered around, and motivated by, the set of Banach limits. This set is a subset of the dual space of l(infinity). This space has two concrete representations. The first is the set rca(beta N) of all regular Borel measures on beta N; the second is the set ba(N2(N)) of bounded, finitely additive set functions on the algebra 2(N) of all subsets of the positive integers. The first part examines the set of Banach limits in the setting of ba(N,2(N)). Suppose p and ba(N,2(N)) is a probability element, and P and rca(beta N) corresponds to p. It is first shown that the support set K sub p is contained in beta N of P is extremally disconnected. The method of proof consists in showing the K sub p is the Stone space of a complete Boolean algebra. In the second part, comments on the extensions of other results are given. A proof of the Radon-Nikodym theorem for complex valued, finitely additive set functions that is, perhaps, more amenable to generalization is given. A Lebesgue decomposition is also obtained. Dissert. Abstr.

N70-22636 Purdue Univ., Lafayette, Ind.
APPROXIMATION-EXTENSION TYPE PROPERTIES OF CURVES

Fon-Che Liu (Ph.D. Thesis) 1968 68 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-7474

The problem of finding a geometrically nicer curve which coincides with a given curve of finite length in most part is considered. Roughly speaking, it is proven that any curve of finite length in R(n) is esentially a continuously differentiable curve in parametric case. In the case of graphs of continuous functions of bounded variation in R(2), it is proven that they are essentially the graphs of continuous functions with continuously turning tangent. The main tool sued in the proof of parametric case is an integral representation for the lengths of curves. In order to handle the case of graphs of continuous functions of bounded variation, a special Hahn decomposition is needed of a closed interval for the signed measures generated by the considered class of functions in the sense of Lebesgue Stieltzes. This decomposition should be of interest by itself. Dissert. Abstr.

N70-22644 Catholic Univ. of America, Washington, D.C.
SOME CONTRIBUTIONS TO THE THEORY OF POSITIVE DEFINITE FUNCTIONS ON GROUPS
Bernard Joseph Mc Cabe (Ph.D. Thesis) 1968 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-8922

A generalization of Bochner's Theorem concerning positive definite functions, when such functions are defined on a locally compact group and when the function has a certain invariant property with respect to a subgroup is presented. This generalization will include and extend a result of I. M. Gelfand concerning bi-invariant positive definite functions. Gelfand carried out the proof of this theorem by using the theory of commutative normed rings, and in order to do this several assumptions concerning the group and its group ring had to be made. By using the recently developed Choquet theory, however, it has been possible to relax virtually all the above-mentioned hypotheses, and, moreover, to consider a more general kind of bi-invariant positive definite function, and still obtain the representation theorem. Dissert. Abstr.

N70-22645 Illinois Univ., Urbana.
SOME ASPECTS OF SPECTRAL THEORY ON BANACH SPACES
Michael Barry Dollinger (Ph.D. Thesis) 1968 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-10686

The spectral decomposition of a certain class of bounded linear operators on a complex Banach space is considered. An operator T in this class has no eigenvalues and its spectrum is a subset of the real numbers. We further assume that T has an A-operational calculus for a certain algebra A of complex-valued functions, each defined on a neighborhood of the spectrum of T; that is, we assume that one may consider functions of the operator T for any function in the algebra A. Some aspects of perturbation theory for bounded operators (on a complex Banach space) which have the single valued extension property are also discussed. This property and the associated concept of the spectrum of an operator localized at a point were introduced. We investigate the continuity of the mapping which, for a fixed vector x in the Banach space, takes an operator having the single valued extension property into the spectrum of that operator localized at the vector x. Dissert. Abstr.

N70-22652 Stanford Univ., Calif.
THE EXPLOSION PROBLEM FOR BRANCHING MARKOV PROCESSES
Thomas Harland Savits (Ph.D. Thesis) 1968 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-8259

Given a branching Markov process, the problem is to determine under what conditions explosion does or does not occur. In the case where the base space is compact and there is no dying, it is shown that under some regularity and communication assumptions explosion occurs with probability zero or one independent of the initial starting point; moreover, the latter happens if the mean time of explosion is finite. Sufficient conditions for explosion or non-explosion are given in the form of the convergence or divergence of certain integrals. Sufficient conditions are also obtained in the general case. Again they depend upon the convergence or divergence of certain integrals, but are of a more local character. For many cases of interest, these sufficient conditions are also necessary. As a particular application of the results, the multi-type branching Markov process and the branching diffusion process with absorbing boundary are discussed. Dissert. Abstr.

N70-22654 Yale Univ., New Haven, Conn.
ONE-POINT PARTS AND THE PEAK POINT CONJECTURE
Brian James Cole (Ph.D. Thesis) 1968 28 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-8331

A general construction is given which associates a function algebra and an onto map to another function algebra in terms of A on X. Every such algebra has one-point parts and zero point derivations on its maximal ideal space. Dissert. Abstr.

N70-22662 Lehigh Univ., Bethlehem, Pa.
MULTIPLIER ALGEBRAS AND SEQUENCE SPACES
Raymond John Mc Givney, Jr. (Ph.D. Thesis) 1968 84 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-7348

Let (e sub i,E sub i) be a biorthogonal system in a linear space X. The space of all diagonal operators from X to X with respect to (e sub i,E sub i) is studied. This space is called the multiplier algebra of (e sub i,E sub i) and is denoted by M(X) when there is only one biorthogonal system under discussion. We study the properties of this space M(X) and its relation to (sub i,E sub i) with varying hypotheses on X and (e sub i,E sub i). Mixtures of gamma-perfect BK spaces are investigated and it is shown that under certain conditions mixtures of gamma-perfect BK algebras containing e are again gamma-perfect BK algebras containing e. This result is used to construct a multiplier algebra of a basis in a Banach space that is neither by nor m. Material developed concerning mixtures is used to construct an example of non-sectionally bounded BK space containing e. Coordinate functionals biorthogonal to the basis for C(0,1) are exhibited and the sequence space associated with this basis is presented. Dissert. Abstr.

N70-22665 Northwestern Univ., Evanston, Ill.
INTERVAL LINEAR PROGRAMMING
Philip David Robers (Ph.D. Thesis) 1968 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-6980

Two iterative techniques for solving the general (IP) are presented which take advantage of its special structure. Numerical experiments indicate that very large computational savings may be realized by solving (IP) by these methods rather than solving the equivalent (LP) using the simplex method. It is also demonstrated hat (IP) is a sufficiently general model to cover all linear programs since (LP) can easily be converted to an equivalent (IP). Consequently, the methods for solving (IP) may be viewed not only as techniques specialized for certain problems, but also as possible alternatives to the standard methods for solving (LP). Numberical experiments indicate that solving (LP) by the simplex method requires slightly more computational effort than converting to an equivalent (IP) and solving by one of the new methods. Dissert. Abstr.

N70-22667 Stanford Univ., Calif.
INTUITIONISTIC ARITHMETIC AS A THEORY OF CONSTRUCTIONS
Nicolas Daniels Goodman (Ph.D. Thesis) 1968 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-8186

The theory of construction is described and proved theoretically equivalent to the intuitionistic arithmetic. The construction theory is formalized as a free variable, type-free theory of partial functions. The universe of the construction theory is stratified into two levels. At the bottom level, certain basic constructions are proved, and at successor levels proofs of purely universal assertions concerning the elements of previous levels are given. A sequency of reduction relations on the closed terms of the construction theory is used in assessing the faithfulness of the interpretation. Dissert. Abstr.

N70-22668 Syracuse Univ., N.Y.
TREES, TRANSDUCERS, AND TRANSFORMATIONS
William Chesley Rounds (Ph.D. Thesis) 1968 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-8255

This paper is an application of generalized finite automata theory to the theory of transformational grammars. Using a tree automation with outputs, a simple analogue of the transformation mapping. A tree transducer works in analog with a (partial) generalized sequential machine in that it has local outputs and state transitions. It differs from a tree automation in that it starts at the root (top) of its input tree and works toward the branches. It thus reverses the action of a tree automation. The inputs to such a transducer are taken from a regular set of trees. Since every set of derivation trees of a context-free grammar is regular, this corresponds to letting a transformation act on a set of context-free (kernel) P-markers. The range of a transformation is a *surface set;* decision problems for these sets are studied. *T-languages* are obtained by concatenating the symbols appearing at the leaves of the trees in a surface set, just as in the context-free case. Dissert. Abstr.

N70-22672 Stanford Univ., Calif.
ON SCATTERING THEORY FOR THE SCHROEDINGER EQUATION
Stanly Lee Steinberg (Ph.D. Thesis) 1968 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-8275

The change in the analytic properties of the scattering operator for the Schroedinger equation with perturbations of the potential is investigated. Some properties of analytic families of compact operators are investigated. The Green's function, the eigenfunctions, and the scattering operator are introduced and it is shown that they are meromorphic vector valued functions. It is proved that the poles of each of these functions on the positive imaginary axis are of first order and the residue at each of these poles is explicitly computed. The converses of these implications are proved under some special conditions. Dissert. Abstr.

N70-22680 Stanford Univ., Calif.
A GENERALIZATION TO OVERDETERMINED SYSTEMS OF THE NOTION OF DIAGONAL OPERATORS
Barry Bruce Mac Kichan (Ph.D. Thesis) 1968 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-8222

Let D: E yields F be a differential operator mapping germs of sections of the vector bundle E to germs of sections of the vector bundle F. The Spencer sequence associated to D is a complex of sheaves and first order operators. Proof that the Spencer sequence is an exact resolution of the sheaf of germs of solutions of the homogeneous equation Du = 0 is given. This would yield local existence theorems for overdetermined systems of partial differential equations. Several consequences of a homological condition on the delta-complex of D called the delta-estimate are considered. This condition seems to be a reasonable generalization to overdetermined systems of the notion of diagonal or uncoupled operators. The importance of these estimates is to prove the Kohn-Nirenberg estimate for the Spencer sequence, and, if D is elliptic, that the D-Neumann problem for D is solvable and that the cohomology of the Spencer sequence is finite dimensional. Dissert. Abstr.

N70-22685 Oregon State Univ., Corvallis.
ZERO ENTROPY AUTOMORPHISMS OF A COMPACT ABELIAN GROUP
Terrance Lee Seethoff (Ph.D. Thesis) 1969 71 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-4087

Characterization of the epimorphisms of a compact metrizable abelian group which have zero entropy is discussed. Three related theorems are proved. Dissert. Abstr.

N70-22687 Illinois Univ., Urbana.
MARTINGALE COMPARISONS
Burgess James Davis (Ph.D. Thesis) 1968 44 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-10678

It is shown that the given condition for Martingale transforms can be replaced by a weaker condition which requires almost no alteration of previous proofs to make the same substitution in a given theorem of a previous paper. A number of related results are proved. Dissert. Abstr.

N70-22702 Iowa State Univ. of Science and Technology, Ames.
ASYMPTOTIC STABILITY IN GENERAL SYSTEMS
John Melvan Clark (Ph.D. Thesis) 1968 70 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-4224

Let (X, U) be an arbitrary uniform space and R be the real numbers. Suppose that the points of X are the states which a given process may attain and that the pair (x,t) denotes the event that the process is in state x at time t. To each point p sub o = (x,t) assign the set F(p sub o) contained in X × R consisting of p together with all events which may follow p in any permissable course of evolution of the process. The collection (F(p) : p in X × R) is considered as a system on X × R. Stability and asymptotic stability of a subset of X × R relative to such a system are defined. The relationship between continuity of a Lyapunov-like function defined for a nonempty subset of X × R and the stability of that set relative to a given system is investigated. These results are applied to give a necessary and sufficient condition that a subset of X be strongly asymptotically stable with respect to a generalized dynamical system defined on X. Dissert. Abstr.

N70-22704 Texas Technological Coll., Lubbock.
SEMI-TOPOLOGICAL PROPERTIES AND RELATED TOPICS
Sterling Gene Crossley (Ph.D. Thesis) 1968 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-8439

Semi-closed sets and semi-closure are defined in topological spaces, and several theorems are proven concerning these concepts. An abstract operator approach is introduced. The concepts of irresolute functions, semi-homeomorphisms, and semi-topological properties are introduced and developed. A theorem is proven showing that first and second category are both semi-topological properties. Semi-topological classes are defined and are used in proving that Hausdorff, separability, and connectedness are semi-topological properties. Dissert. Abstr.

N70-22705 Syracuse Univ., N.Y.
ASYMPTOTIC BEHAVIOR OF MEROMORPHIC FUNCTIONS WITH EXTREMAL DEFICIENCIES
Allen William Weitsman (Ph.D. Thesis) 1968 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-7790

Symbols of frequent use in Nevanlinna's theory of meromorphic functions are reviewed. The structure of the sets was established, and the limits of the measures of these sets were determined. Asymptotic evaluation of functions is provided. Dissert. Abstr.

N70-22713# Wisconsin Univ., Madison. Dept. of Computer Sciences.
NON-LINEAR EIGENVALUE PROBLEMS FOR SOME FOURTH ORDER EQUATIONS: 1. MAXIMAL SOLUTIONS
Seymour V. Parter Oct. 1969 42 p refs
(Contract N00014-67-A-0128-0004)
(AD-698312; TR-75) CSCL 12/1

A constructive, nonlinear iterative method is developed for the construction of a 'positive' solution of a nonlinear fourth order ordinary differential equation in terms of (u(t), theta (t)). A solution is positive if u(t) is < or = to 0 < or = to theta (t). Under appropriate hypothesis, the solutions are 'maximal' in the sense that if (omega, phi) is any other solution, then u < or = to omega, phi < or = to phi. Thus, bounds on (u, theta) are a priori bounds on all solutions. Uniqueness is discussed. In special cases these positive solutions may be patched together to give other solutions.
Author

N70-22720 Virginia Univ., Charlottesville.
COMMUTANTS OF A CLASS OF OPERATORS
Thomas Latimer Kriete, III (Ph.D. Thesis) 1968 67 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-3989

The commuting algebra is found of any contraction operator T on a Hilbert space which is completely non-unitary and for which rank (I - T*T) = rank (I - TT*) = 1. The algebraic and topological structure of this algebra is studied and it is shown that it is a dual space, among other things. Operators on L(2)(0,1) of the form (2 -V)(2 + V)(-1)U where U is a unitary multiplication operator and V is the Volterra operator are considered. When such an operator is completely non-unitary earlier results to find the commuting algebra of (2 -V)(2 + V)(-1)U are used. Dissert. Abstr.

N70-22721 New York Univ., N.Y.
RIEMANN'S PROBLEM FOR THE EQUATION OF ONE-PARAMETER FAMILY OF INITIAL VALUE PROBLEMS
Porter Dean Gerber (Ph.D. Thesis) 1968 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-7951

The solution to the one-parameter family of initial value problems characterized by a certain equation is treated. The solution depends on sigma: v = v sub sigma(x,t). Convergence to zero and a solution to Riemann's problem for sigma = 0 are sought. Dissert. Abstr.

N70-22723 Lehigh Univ., Bethlehem, Pa.
CHARACTERIZATIONS AND APPLICATIONS OF SEQUENTIAL NORMS
Edwin Joseph Kay (Ph.D. Thesis) 1968 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-7343

A sequential seminorm (norm), N, is an extended seminorm (norm) on the s, the space of all sequences, with the property that N(x) = Sup sub n N(x(< or = to n)) for x in s. The properties of N and S(N) = (x: N(x) < infinity) are studied. Dissert. Abstr.

N70-22724 Lehigh Univ., Bethlehem, Pa.
CONTINUOUS DECOMPOSITIONS
Daniel John Fleming (Ph.D. Thesis) 1968 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-7332

A Schauder decomposition for an F-space X is a certain sequence of closed subspaces of X. A generalized Schauder decomposition of a linear topological space is introduced and generalized Schauder decompositions of different types are studied on various classes of linear topological spaces. The notion of a generalized coordinate space (g.c.s) and the dual of a g.c.s. are defined in terms of a net of projections on a linear space and the weak topology on such a space by its dual is studied. A g.c.s. is called perfect if it is maximal with respect to its dual. It is shown that if the net of projections is equicontinuous then a necessary and sufficient condition for completeness is that X be perfect. Dissert. Abstr.

N70-22726 Carnegie-Mellon Univ., Pittsburgh, Pa.
INTERPOLATION OF SUBLINEAR OPERATORS ON GENERALIZED ORLICZ AND HARDY SPACES
William Theodore Kraynek (Ph.D. Thesis) 1968 100 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-7903

The Reisz-Thorin interpolation theorem is proved for sublinear operators on certain generalized Orlicz spaces. The corresponding interpolation theorem for the Hardy-Orlicz spaces is also obtained. The interpolation theory above is extended to the case when there are certain factors, resembling the Radon-Nikodym derivatives of measures, included. Interpolation of multilinear operations with factors is also treated in the Orlicz spaces. Finally, the interpolation of a family of operators which depend on a smooth parameter is obtained. Dissert. Abstr.

N70-22734 Illinois Univ., Urbana.
MEASURABLE CARDINALS AND NTT
James Delbert Davis (Ph.D. Thesis) 1968 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-10679

This thesis considers Takeuti's system of transfinite type theory, NTT. It is shown that if Zermelo-Frankel set theory with the axiom of choice, the omega-rule, and the assumption of the existence of a measurable cardinal is consistent, then NTT is consistent. Also it is shown what additional assumptions are required to establish the consistency of MTT, an extension of NTT. A number of technical results concerning NTT are derived, including a truth-definition for sentences of degree n without the node variable, which is a formla of degree n+1. It is also shown that if k is a measurable cardinal, then the set of cardinals less than k which are indescribable with respect to properties expressible by formulas of NTT has power k. Dissert. Abstr.

N70-22740*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
SIMULTANEOUS ESTIMATION OF THE STATE AND NOISE STATISTICS IN LINEAR DYNAMICAL SYSTEMS
Paul D. Abramson, Jr. (Ph.D. Thesis—MIT, May 1968) Washington Mar. 1970 351 p refs
(NASA-TR-R-332; C-88) Avail: CFSTI CSCL 12A

An optimal procedure is developed for estimating the state of a linear dynamical system when the statistics of the measurement and process noise are poorly known. The criterion of maximum likelihood is used to obtain an optimal estimate of the state and noise statistics. These estimates are shown to be asymptotically unbiased, efficient, and unique, with the estimation error normally distributed with a known covariance. The resulting equations for the estimates cannot be solved recursively, but an iterative procedure for their solution is presented. Several approximate solutions are

presented which reduce the necessary computations in finding the estimates. Some of the approximate solutions allow a real time estimation of the state and noise statistics. Numerical results of a digital computer simulation of the optimal and suboptimal solutions of the estimation problem are presented for a simple but realistic example. Author

N70-22744 Stanford Univ., Calif.
PART 1: EPSILON CALCULUS PART 2: ITERATED INTEGRALS
Paul Lawrence Richman (Ph.D. Thesis) 1968 189 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-8250

Recursive function theory was used to lay the basis for a partially constructive theory of calculus. This theory differs from other theories that have grown out of recursive function theory in that (1) it is directly related to variable-precision computations used in scientific computation, and (2) it deals explicitly with intermediate results rather than ideal answers. A specific numerical problem is discussed arising from S. Bergman's solution to the initial-value problem for a partial differential equation of compressible fluid flow. This work necessitated the discovery of an efficient approximation to the iterated indefinite integrals of an implicitly defined real function of one real variable. The method of approximation used and the subsequently derived error bounds appear to have general applications to the iterated integrals approximation of a singular function of one real variable. Dissert. Abstr.

N70-22747 Maryland Univ., College Park.
A CLASS OF NON-LINEAR DIFFERENTIAL EQUATIONS WITH STATE DEPENDENT HEREDITARY EFFECTS
Elliot Winston (Ph.D. Thesis) 1968 71 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-7645

Various problems concerning the behavior of solutions of (DDE) are studied: uniqueness of the zero solution, oscillations of solutions, and the existence of nontrivial solutions. Asymptotic equivalence between solutions of (DDE) and those of the associated ordinary differential equation is also considered. Dissert. Abstr.

N70-22760 Iowa Univ., Iowa City.
CHARACTERIZATIONS OF A CONDITIONAL EXPECTATION WITH RESPECT TO A SIGMA-LATTICE
Richard Lynn Dykstra (Ph.D. Thesis) 1968 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-8730

A conditional expectation with respect to a sigma lattice can be considered as a transformation which maps the set of square-integrable functions back into itself. Certain properties of a transformation are shown to be necessary and sufficient for the transformation to be a conditional expectation with respect to a sigma lattice. The problem is considered for the two cases where one has an arbitrary measure space and where one has a totally finite measure space. Also considered is the problem of characterizing sets of lattice measurable functions. Necessary and sufficient conditions are found to insure that a set of functions is the set of lattice measurable functions for some sigma lattice. This problem is also treated for the two cases where one has a totally finite measure space and where one has an arbitrary measure space. Dissert. Abstr.

N70-22788# Stanford Univ., Calif. Dept. of Computer Science.
METHODS OF SEARCH FOR SOLVING POLYNOMIAL EQUATIONS Technical Report
Peter Henrici Dec. 1969 29 p refs
(Contract N00014-67-A-0112-0029)
(AD-698798; CS-145) Avail: CFSTI CSCL 12/1

The problem of determining a zero of a given polynomial with guaranteed error bounds, using an amount of work that can be estimated a priori, is attacked by means of a class of algorithms based on the idea of systematic search. Lehmers machine method for solving polynomial equations is a special case. The use of the Schur-Cohn algorithm in Lehmers method is replaced by a more general proximity test which reacts positively if applied at a point close to a zero of a polynomial. Various such tests are described, and the work involved in their use is estimated. The optimality and non-optimality of certain methods, both on a deterministic and on a probabilistic basis, are established. Author (TAB)

N70-22806 Tennessee Univ., Knoxville.
POSITIVE CLIFFORD SEMIGROUPS ON THE PLANE
Reuber William Farley (Ph.D. Thesis) 1968 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-7156

This work is devoted to a preliminary investigation of positive Clifford semigroups on the plane. A positive semigroup is a semigroup which has a copy of the non-negative real numbers embedded as a closed subset in such a way that 0 is a zero and 1 is an identity. A positive Clifford semigroup is a positive semigroup which is the union of groups. In this work it is shown that if S is a positive Clifford semigroup on the plane, then each group in S is commutative. Are two positive semigroups on the plane which have isomorphic semilattices of idempotent elements necessarily iseomorphic? The question is answered in the negative with a counter example, and then necessary and sufficient conditions are given in order that two such semigroups be iseomorphic. Dissert. Abstr.

N70-22836 Utah Univ., Salt Lake City.
CHARACTERIZING WERKFELDER OF CERTAIN CLASSES OF SUMMABILITY METHODS
John Roy Edwards (Ph.D. Thesis) 1968 42 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-4174

The problem of giving characterization of the Werkfelder of summability methods in two settings is investigated. In the first methods from an ordered group into a topological group are considered; in the second, methods from a first countable group to a commutative first countable group are considered. In the first setting investigations are limited to methods which satisfy an order criterion, which in the classical setting is equivalent to the condition that the sign of the entries of any one row is constant. In this setting it is proved that a sequence (x(n)) is in the Werkfeld if and only if there are sequences of finitely nonzero sequences which approach (x(n)) from above and below such that the partial sums of the method operating on these sequences are Cauchy and Cauchy equivalent. Dissert. Abstr.

N70-22837 California Univ., Berkeley.
RANDOM ORDINARY DIFFERENTIAL EQUATIONS
Richard Warren Edsinger (Ph.D. Thesis) 1968 53 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-10283

Existence and uniqueness theorems are derived for solutions (in the mean) of the random differential equation: This is accomplished by determining when a sample path solution is also a solution in the mean. f(x,t,omega) is required to satisfy a generalized Libschitz condition. The usual definition of mean stability is generalized to, what is shown to be, a more useful form[L(p,q) stability]. For the linear equation x' = A(t,omega)x, conditions for L(p,q) stability are given in terms of a fundamental matrix solution. Particular attention is given to the case where the variance of A(t,omega) goes to zero with time. For this case theorems are developed which relate L(p,q) stability to the stability of the nonrandom average problem. Finally theorems relating almost sure stability to the stability of the average problem are derived. Dissert. Abstr.

N70-22839 Wisconsin Univ., Madison
SOME RESULTS ON THE LINEAR GROUPS
Joseph Burke Dennin, Jr. (Ph.D. Thesis) 1968 70 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-13987

A contribution toward proving a conjecture of H. Rademacher is made and some results of W. Klingenberg are extended. Let Gamma be the 2 × 2 modular group, Gamma(n) the principal congruence subgroup of level n. G has a fundamental domain in the upper half-plane which can be compactified into a Riemann surface and the genus of the surface is referred to as the genus of G. H. Rademacher has conjectured that the number of congruence subgroups G of Gamma of genus O is finite. D. McQuillan has shown that if the level of G is prime to 2.3.5, the conjecture is true. Let L be a local ring, GL(L) the general linear group over L and Sp(L) the symplectic group over L. W. Klingenberg has classified the normal subgroups of GL(L) and Sp(L). Suppose R is a semi-local ring which can be expressed as a direct sum of local rings. This fact and the results of Klingenberg are used to classify normal subgroups of GL(R) and Sp(R). Dissert. Abstr.

N70-22840 Tennessee Univ., Knoxville.
PSEUDO-ORDERED FUNCTIONS OVER A FINITE FIELD SATISFYING A PERMUTATION CONDITION
James Alan Smith (Ph.D. Thesis) 1969 95 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-7183

A finite field involving prime numbers is given. A mapping function of the field is defined for the various elements. A theorem is proven involving permutation polynomials within the field. Necessary and sufficient conditions that a function satisfy are given in terms of the domains and ranges of the functions in the theorem. The concept is then extended to functions of any number of variables in another theorem. Dissert. Abstr.

N70-22879 Miami Univ., Fla.
THEORY OF k-SPACES
Donald Derrick Weddington (Ph.D. Thesis) 1968 53 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-6520

In the present work the theory of k-spaces is extended and the more restrictive k'-spaces are also studied. Two properties are introduced to characterize the k-subspaces of Hausdorff spaces. One of these properties turns out to be useful in our determination of a characterization for k'-spaces. Quasi-compact mappings which preserve k-spaces are concerned. Thus, hereditary quasi-compact mappings are introduced and it is shown that k'-spaces are preserved under these mappings. Cosmic spaces are used in an effort to determine when k-spaces are first countable. Since cosmic k-spaces are too weak to achieve this goal we find it necessary to employ k'-spaces. Product theorems are obtained for k'-spaces and countably compact k-spaces. And finally a result is obtained for topological groups which are k-spaces. Dissert. Abstr.

N70-22880 Johns Hopkins Univ., Baltimore, Md.
MULTI-COMMODITY DISCONNECTING SETS IN UNDIRECTED GRAPHS BY NODE PARTITIONING
Gerald Earl Bennington (Ph.D. Thesis) 1969 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-21112

Two formulations and a method of solution are presented for the problem of determining a minimum multi-commodity disconnecting set for undirected graphs. The algorithm determines a partitioning of the nodes of the graph in such a manner that the total iteration between the partitioned sets is a minimum. The method of node partitioning is also shown to be useful for a special case of the quadratic assignment problem. The algorithm developed utilizes a branch and bound algorithm to determine the best integer solution resulting from a series of decomposed linear programs. The characteristics of non-integer basic solutions to these linear programs are discussed and several examples are given. Dissert. Abstr.

N70-22887 City Univ. of New York.
ON WEYL'S IDENTITY
Martin Katzen (Ph.D. Thesis) 1969 35 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-7602

The verification and derivation of Weyl's identity problem is considered. A corrected identity was found which leaves some applications unaffected but does show that some of Wintner's formulas are not correct. In particular, the a priori bound for the mean curvature is correct. The related results derived by Chern turns out to imply the corrected identity and not Weyl's identity. Other results obtained by Wintner are corrected which are not consequences of his working with the wrong identity. Dissert. Abstr.

N70-22890 California Univ., Los Angeles.
THE HOMOLOGY OF LOCALLY FINITE CW COMPLEXES
Dennis Lee Johnson (Ph.D. Thesis) 1968 326 p
Avail: Univ. Microfilms: HC $14.85/Microfilm $4.20 Order No. 69-7248

A detailed study is initiated of the generalization of some of the known facts of algebraic topology in the domain of compact objects to the nice domain of locally compact spaces and locally finite CW complexes. Given the homology of a point (the coefficient group) there is an essentially unique homology theory on the category of finite CW complexes inducing the given coefficient group; if the point is considered as a trivial category, then any homology theory on this category (which is just the assignment of a coefficient group) extends uniquely to a homology theory on the finite CW category. This theory is no longer uniquely extendible to the category ELF of locally finite CW complexes. Dissert. Abstr.

N70-22900 Pennsylvania Univ., Philadelphia.
PHYSICAL STATES ON A C*-ALGEBRA
Johan Fredrik Aarnes (Ph.D. Thesis) 1968 17 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-5600

Conditions under which a quasi-state is linear, i.e., when it is a state in the traditional sense is discussed. In somewhat less general form, this problem was first proposed by Mackey, and solved in a very special case by Gleason. In its present form, the problem is due to R. V. Kadison. It has bearings on quantum mechanics, where it corresponds to the question of linearity of the expectation-functional on the algebra of observables. In the present work, it is shown that a quasi-state on an abelian C-algebra is always linear. As one does for states, one may introduce pure quasi-states. It is shown that each pure and norm-continuous quasi-state on a CCR-algebra is linear. Some other special cases are also treated. Dissert. Abstr.

N70-22924 Montana State Univ., Missoula.
TCHEBYCHEFF APPROXIMATIONS BY GENERAL SPLINE FUNCTIONS
Leroy Reuben Amunrud (Ph.D. Thesis) 1968 49 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-7893

A development of the theory of Tchebycheff approximations by polynomials with imposed boundary conditions and the theory of Tchebycheff approximations by general spline functions is presented. Existence and characterization theorems are given along with computational procedures and examples. Dissert. Abstr.

N70-22926 Iowa Univ., Iowa City.
RIGHT ALTERNATIVE RINGS
Irvin Roy Hentzel (Ph.D. Thesis) 1968 53 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-8744

A right alternative ring is a non-associative ring in which (ab)b = a(bb) is assumed to hold for all elements a and b. In right alternative rings a decomposition is developed for right alternative rings with an idempotent e and characteristic not 2 much like the Peirce decomposition in the associative case. Dissert. Abstr.

N70-22927 Iowa Univ., Iowa City.
V-SEMI-REFLEXIVITY, V-REFLEXIVITY AND QUASI-REFLEXIVITY IN LOCALLY CONVEX SPACES
Robert Henry Lohman (Ph.D. Thesis) 1968 66 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-8768

Let E(tau) be a locally convex Hausdorff space, V a linear subspace of E. E is V-semi-reflexive if the canonical embedding of E into V' is onto. Some useful criteria are given to determine when E is V-semi-reflexive. Dissert. Abstr.

N70-22939# RAND Corp., Santa Monica, Calif.
HOMOGENEOUS FAMILIES OF SEMIORDERS AND THE THEORY OF PROBABILISTIC CONSISTENCY
Fred S. Roberts Oct. 1969 42 p refs
(Contract F44620-67-C-0045)
(AD-698320; RM-5993-PR) Avail: CFSTI CSCL 5/10

The work investigates various conditions making precise the observation that the preferences of an individual or group, although not absolutely consistent, are in a sense probabilistically consistent. The Memorandum studies conditions of probabilistic consistency on a family of binary relations, which can be interpreted at several individuals relations of preference or the preference relations of a particular individual obtained at different times. The conditions studied all mean more or less that the family of relations is a homogeneous or consistent family of semiorders. The main result is that almost all of the probabilistic consistency conditions studied are equivalent. The logical relations among all these conditions are described, and findings are compared with some recent work by Tversky and Russo. Author (TAB)

N70-22948 Virginia Univ., Charlottesville.
PERTURBED EIGENVALUES
Richard Hindman Bouldin (Ph.D. Thesis) 1968 57 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-4008

The Weinstein–Aronszajn formula for the change in the multiplicity of an isolated eigenvalues of finite multiplicity under finite dimensional perturbations and studies of the notion of singular spectra is developed. All of the operators considered are self adjoint and densely defined in an infinite dimensional complex separable Hilbert space. The unperturbed operator is not necessarily bounded. The Weinstein –Aronszajn formula is obtained under hypotheses properly weaker than the hypothesis isolated eigenvalue of finite multiplicity. With only parts of the hypotheses generalization inequalities are derived for the perturbed multiplicity. The hypotheses of the generalizations are studied and alternative sufficient conditions are developed. A definition for singular spectra are developed. Also a theory for the behavior of singular spectra under finite dimensional perturbations is proved. Dissert. Abstr.

N70-22972 Virginia Univ., Charlottesville.
RELATIVE BORDISM THEORIES
George Edward Mitchell (Ph.D. Thesis) 1968 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-18222

The bordism theories are developed for compact differentiable manifolds with boundary. Two cases are considered. The first deals with compact smooth manifolds with oriented boundary. In the second case compact smooth manifolds with a weakly complex structure on its boundary are studied. Dissert. Abstr.

N70-22979# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF NONLINEAR OSCILLATIONS WITH THE AID OF LYAPUNOV FUNCTIONS
G. V. Kamenkov 18 Aug. 1969 51 p refs Transl. into ENGLISH from Univ. Druzhby Narodov, (Moscow), v. 15, no. 3, 1966 p 3–55
(AD-698527; FTD-HT-23-177-69) Avail: CFSTI CSCL 12/1

In Ch. 1, Autonomous Systems, the author considers the system of two equations. The conditions for the existence and stability of a periodic solution are established. The following method is used: we convert to polar coordinates and seek the Lyanunov function V in implicit form. Criteria for the stability or instability of the sought cycle are also established in the form of the function L(subscript 1) (V), and a method for finding an approximate equation of limit cycles is indicated; estmates of the value of the small parameter Mu, for which the theory being developed can be used, are given. The author then considers cases in which studies of more general systems of two equations can be reduced to the study of previously analyzed particular cases. At the end of the chapter the author discusses the feasibility of using Lyapunov functions to find stationary (generally speaking, nonperiodic) oscillations for multidimensional systems as well, but gives no computations. Ch. 2, Nonautonomous Systems, briefly reviews the theory of obtaining stationary oscillations. TAB

N70-22981 Virginia Univ., Charlottesville.
SPECTRAL THEORY OF SYSTEMS OF TOEPLITZ AND SINGULAR INTEGRAL OPERATORS
William Tilford England (Ph.D. Thesis) 1968 42 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-3990

The spectral multiplicity function of both Toeplitz and singular integral operators acting on scalar functions is described in the literature. Variations of the techniques used in the scalar theory are applied to examine classes of Toeplitz operators acting on vector valued functions and of singular integral operators with vector integrands. Because of the close connection between singular integral operators and solutions of the commutator equation, the description of the multiplicity function for such operators has wide interest. The techniques used involve the solution of the resolvent equation by the use of the analytic, outer factors of a positive definite matrix function defined on the circle or on the line. The multiplicity theory then follows from a careful analysis of the solutions. Consequently the classes of operators studied are ones for which an outer factorization can be given analytic form. The analytic representation of the outer factors associated with more general classes of positive definite functions is one of the outstanding unsolved problems of vectorial function theory. Dissert. Abstr.

N70-22985 Yale Univ., New Haven, Conn.
A GENERALIZATION OF SCHUR'S THEOREM
Jon Henry Sanders (Ph.D. Thesis) 1968 41 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-8427

Mathematical operations are described showing that for given positive integers there exists a positive integer with a subset divided into any number of classes. From these classes it is shown that there exists any number of distinct positive integers and one positive integer exists which is greater than or equal to the number of classes of the subset. Some theorems are proven for circuit isomorphisms and one-way circuit isomorphism. Dissert. Abstr.

N70-22986 Maryland Univ., College Park.
EXTREME POSITIVE OPERATORS
Mary Solveig Espelie (Ph.D. Thesis) 1968 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-9601

Definitions are given for commutative, complex Banach algebras A and B with identity and isometric involution. The space of continuous linear operators from A to B are also described for the Banach algebras. Using set theory it is shown that there exists a finite set of elements of the Banach algebra B, which is a set of positive operators generating a cone. A convex set of this cone is considered, and with proper limitations and mathematical operations, it is shown in Banach algebra B that the set of extreme points of the convex set is the set of positive multiplicative operators, assuming that the Banach algebra B is semisimple and symmetric. These results can then be extended to include algebras with bounded approximate identities. Dissert. Abstr.

N70-22991 New York Univ., N.Y.
DIFFERENCE APPROXIMATIONS FOR BOUNDARY-VALUE PROBLEMS OF CONSERVATIVE EQUATIONS
Milton Halem (Ph.D. Thesis) 1968 67 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-7957

Implicit difference equations are considered for boundary value problems of nonlinear hyperbolic, conservative systems. The conservation properties for such systems couple the boundary conditions to the time rate of change of the integrals of the unknown quantities over the entire space domain. The difference equations are derived by approximating the integral forms over small volume elements. Integral forms governing first and second order approximations are obtained, and the difference equations of first order are considered. The resulting difference schemes are shown to possess a global approximation of the conservation property. Three gasdynamic problems were used to test these difference schemes. They were the resolution of initial discontinuities, the propagation and decay of shock waves and the multiple reflections for a moving piston in a closed tube. The numerical computations from an IBM 7094 are compared with analytic and asymptotic results. Dissert. Abstr.

N70-22995 Maryland Univ., College Park.
NEAR ISOMETRY OF BANACH SPACES AND THE BANACH-MAZUR DISTANCE
Robert Alister Mc Guigan, Jr. (Ph.D. Thesis) 1968 76 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-7633

The isomorphism class of a Banach space X is defined to be the class of all Banach spaces isomorphic to X, with isometric spaces identified; D is shown to be a pseudometric on the isomorphism class. We call D the Banach-Mazur distance, and if D(X,Y) = 0, then X and Y are said to be nearly isometric. The purpose of the thesis is to examine some topological properties of the isomorphism class with the topology defined by D, and to consider the concept of near isometry. Dissert. Abstr.

N70-22997 Maryland Univ., College Park.
ON SLICES, CLOSED SLICES AND GLOBAL SLICES IN A G-SPACE
Larry King (Ph.D. Thesis) 1968 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-8048

Important to the study of a G-space X, for G a topological group and X a Hausdorff space is the idea of a slice at a point x epsilon X in the sense of Palais. The question of existence of slices, closed slices and global slices is considered here together with some of the interrelationships of these notions. The paper begins with an example of a G-space X in which there is no slice at any x epsilon X and with an example of one where there is a slice at every point, with G not compact and with X not Cartan. Suppose H is a closed subgroup of G and X is an H-space by restriction. If S is a slice at x in the H-space X then necessary and sufficient conditions are given for S to be a slice at x in the G-space X. This result leads to the existence of a slice at each point of a G-space X which is more general than a Cartan G-space. Sufficient conditions are obtained for a slice S at a point in the H-space X to imply the existence of a slice S' at x in the G-space, S' not necessarily equal to S. Dissert. Abstr.

N70-23024 Dartmouth Coll., Hanover, N.H.
THE PRESENT STATE OF ORDINAL NOTATION THEORY
Frederick Stuart Gass (Ph.D. Thesis) 1968 249 p
Avail: Univ. Microfilms: HC$ 11.25/Microfilm $3.25 Order No. 69-5215

A unified, comprehensive discussion of ordinal notion theory is given within the framework of recursive function theory. Class II sub c of constructive ordinals from various approaches include r-systems, recursive well-orderings, recursive finite-path trees, and recursive well-foundings (a rllation is a well-founding if it includes no infinite descending chains). These approaches are generalized from the recursive level to higher prefix classes with extensions of II sub c to higher constructive number classes. The theory of ordinal notation based on well-foundings is developed simultaneously with the theories based on well-orderings and finite-path trees. Dissert. Abstr.

N70-23045# Idaho Nuclear Corp., Idaho Falls.
ANALYSIS OF FAULT TREES BY KINETIC TREE THEORY
W. E. Vesely Oct. 1969 94 p refs
(Contract AT(10-1)-1230
(IN-1330) Avail: CFSTI

A methodology is developed by which exact and detailed reliability information is obtained for any system fault tree. The system, called Kinetic Tree Theory is believed to be a major advancement in the field of reliability analysis. The first assumption is that the components of the fault tree are independent; one component may occur at any number of places in the fault tree, but those components which are unique are assumed independent. The second assumption is that the minimal cut sets of the method are known. Fault trees of any structure and complexity are handled, and the expressions developed are in a simple form. Application to yield numerical results is straightforward. Author

N70-23074 Iowa Univ., Iowa City.
THE H SUP p SPACES AND NON-RECTIFIABILITY
Michael Robert Cullen (Ph.D. Thesis) 1968 82 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-878

Geometric aspects of the classical H(p) spaces of analytic functions in the unit disc are discussed, along with more general notion of H(p) spaces in multiply connected Jordan regions. The interior of a simple closed curve is simply connected, and hence by the Riemann mapping theorem, there exists 1-1 analytic function from unit disc onto interior closed curve. Dissert. Abstr.

N70-23075 California Univ., Los Angeles.
CLOSED FORM SOLUTIONS OF SOME REGULAR INTEGRAL EQUATIONS
John Rudolph Hatcher (Ph.D. Thesis) 1968 95 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-8098

Solutions of boundary problems for analytic functions are used to get closed-form solutions of linear and nonlinear singular integral equations. In the main part of the work, it consists not so much in the reduction to problems of Riemann-Hilbert type as in the techniques used to attack the Riemann-Hilbert problems. It

is thought that the field of closed-form solutions for nonlinear singular equations was relatively inaccessible, and that our positive results in this direction, though special, may suggest avenues of further research. Dissert. Abstr.

N70-23091 Polytechnic Inst. of Brooklyn, N.Y.
TOLERANCE POLICIES FOR PERIODIC FIELD CHECKOUT
Bernard Schwartz (Ph.D. Thesis) 1969 139 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-20365

Determining where to draw tolerance limits for periodic checkout of equipment is discussed. In order to make the proper decisions, a test and repair model is generated to show how system accuracy, costs, and availability are affected by catastrophic and performance failure rates, failure rate increase due to handling, and the density function of added error due to performance failures. Techniques for making the computations are presented. Dissert. Abstr.

N70-23155 Iowa Univ., Iowa City.
LOCALLY TAMING 2-MANIFOLDS WITH BOUNDARY ON ONE SIDE AND TAMING TOPOLOGICAL COMPLEXES IN E(3)
Victor Alvin Nicholson (Ph.D. Thesis) 1968 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-8784

Let Y be a closed subset of a 3-manifold N. A subset U of N is called a mapping cylinder neighborhood (MCN) of Y under certain given conditions. It is shown that a set in E sup 3 which is closed and homeomorphic to a locally finite geometric complex is tame if and only if it has a MCN. The MCN's are localized in the form of 1-sided MCN's and it is shown that if M is a 2-manifold with boundary lying in a 3-manifold and p is a point of M which has a 1-sided MCN on one side of M, then M is locally tame from that side at p. It is shown that if N is a 3-manifold with boundary and G is an upper semicontinuous decomposition of N all of whose nondegenerate elements lie in Bd N and are cellular in Bd N, then N/G is a 3-manifold with boundary. A new type of MCN is defined for the interior of an n-frame and its existence is shown to imply that the interior of the n-frame is tame. It is known that a 2-manifold which can be pushed with a homotopy into each complementary domain is tame. This theorem is localized and extended to 2-manifolds with boundary. Three theorems about maps with preserve tameness are proved. Dissert. Abstr.

N70-23159 Oregon State Univ., Corvallis.
EQUIVARIANT STIEFEL-WHITNEY CLASSES
Robert Carl Johnson (Ph.D. Thesis) 1969 63 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-4662

A category of vector bundles and a function of the vector bundles are given. A subcategory of the vector bundles is then considered whose objects are a vector bundle and a psuedo-group of local bundle maps, and whose morphisms are equivariant bundle maps. A maximal extension is constructed to the full subcategory. This extended function is natural with respect to morphisms in the subcategory and constitutes the primary obstruction to equivariant cross-sections in the associated frame bundle of appropriate dimension. Dissert. Abstr.

N70-23160 Cornell Univ., Ithaca, N.Y.
OMEGA-COHESIVE SETS
Barbara Falkenbach Ryan (Ph.D. Thesis) 1968 35 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-5031

A set of nonnegative integers, a set of isols, and an isol of a set are described. A definition is given, utilizing a mathematical (Ramsey's) theorem to show that every infinite set of integers has an n-cohesive subset under specified conditions. It is further shown that every subset of a set of nonnegative integers is omega cohesive if it is n-cohesive. It is shown that every infinite set has an omega cohesive subset and that an infinite subset of an omega cohesive set is omega cohesive. Proof is also given for the existence of isols of an omega cohesive set. Dissert. Abstr.

N70-23196 Maryland Univ., College Park.
STIELTJES STOCHASTIC INTEGRALS
Richard Hyman Shachtman (Ph.D. Thesis) 1968 59 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-7628

An interval in an arbitrary Banach space is shown. Three definitions of the Stieltjes stochastic integral are given involving a scalar-valued function: one is a weak limit for which a representation is established in the form of a generalized integration by parts formula; another is the pointwise definition via the sample path functions and conditions for the latter to be of bounded variation are indicated; the last is the extension of the mean square case and the resulting second order calculus to a random time integral. Conditions for existence and comparisons are mentioned. Dissert. Abstr.

N70-23197 New York Univ., N.Y.
METRIC CONDITIONS THAT IMPLY LOCAL INVERTIBILITY
Julian Gevirtz (Ph.D. Thesis) 1968 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-7952

Generalizations are given involving an n-dimensional Euclidian space and a continuous mapping of an open subset of the n-dimensional Euclidian space into the n-dimensional Euclidian space. A result is established which is a partial generalization of a proven theorem about piecewise linear mappings. It is proven that the continuous mapping is a local homeomorphism in the open subset, and the continuous mapping is differentiable, thus establishing the existence of a Jacobian determinant. The existence of metric conditions and local invertibility are shown from the proof of the continuous mapping being a homemorphism in the open subset. This proof relies heavily on the theory of degree and the techniques of the theory of quasiconformal mapping in space. Dissert. Abstr.

N70-23215# Aberdeen Research and Development Center, Aberdeen Proving Ground, Md.
AN INVESTIGATION OF THE CHARACTERISTICS OF BAYESIAN CONFIDENCE INTERVALS FOR ATTRIBUTE DATA
Alan W. Benton Nov. 1969 31 p refs
(AD-698466; ARDC-TM-14) Avail: CFSTI CSCL 12/1

The purpose of this investigation was to determine the effect of some prior distributions on Bayesian confidence intervals, where the sample outcomes are either a success or a failure. It is assumed that the prior distribution may be represented by the beta distribution. Author (TAB)

N70-23268# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory.
ABSTRACT SPACES AND SOLUTION OF EQUATIONS
Roger F. Harrington Oct. 1968 63 p refs
(MB-28) Avail: CFSTI

Abstract spaces, mapping, and solution of equations together with their definitions are discussed. ESRO

N70-23285 Nebraska Univ., Lincoln.
NONLINEAR BOUNDARY VALUE PROBLEMS AND SECOND ORDER DIFFERENTIAL EQUATIONS

Lynn Harry Erbe (Ph.D. Thesis) 1968 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-9620

A nonlinear second order differential equation is considered with sufficient conditions given for the existance of a solution satisfying one of three nonlinear boundary consitions on a compact interval with continuous and non-decreasing functions. Various results are proved concerning the relationship between disconjugacy of the first variation equation and uniqueness of solutions of the two point boundary value problem. These results are also extended to a half infinite interval where the third order linear differential equation is studied. Dissert. Abstr.

N70-23288*# Pittsburgh Univ., Pa. Dept. of Electrical Engineering.
SEMI-GROUPS, GROUPS AND LYAPUNOV STABILITY OF PARTIAL DIFFERENTIAL EQUATIONS
William G. Vogt, Gabe R. Buis, and Martin M. Eisen 15 Feb. 1970 64 p refs
(Grant NGR-39-011-039)
(NASA-CR-109364) Avail: CFSTI CSCL 12A

The stability of certain classes of partial differential equations can be rigorously investigated by extending the definition of the formal partial differential operators and obtaining operator differential equations in Hilbert spaces. Under appropriate restrictions the properties of solutions to these partial differential equations can be investigated by using the theory of one parameter semi-groups or groups of linear bounded transformations in the corresponding Hilbert spaces. This leads to a Lyapunov stability theory for partial differential equations. Author

N70-23320*# Texas Univ., Austin.
TWO SQUARE ROOT ALGORITHMS UTILIZING MULTIPLICATION AS THE ITERATIVE OPERATOR
James Richard Goodman (M.S. Thesis) Aug. 1969 86 p refs
(Grant NGR-44-012-144)
(NASA-CR-109329) Avail: CFSTI CSCL 12A

The hardware algorithms are presented which utilize high speed multiplication and no division to perform the square root operation rapidly. One algorithm is intended for a large general purpose computer and in addition provides a second-order division scheme. The second algorithm requires a special function generator which is presently utilized in certain existing computers. Each algorithm is considered for convergence rate, variance, accuracy and implementation. The effect and importance of the initial approximation is considered. A simulation is performed to compare each to a conventional algorithm. Although both algorithms are intended strictly for hardware implementation, either may find an application using microprogramming, and under certain conditions, one might be implemented in software. Author

N70-23348# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
REFORMALIZATION OF A QUADRATIC INTERACTION IN THE HAMILTONIAN FORMALISM
J. Ginibre and G. Velo (Univ. di Bologna) Feb. 1970 33 p refs
(Rept-70/7) Avail: CFSTI

The method of the dressing transformation is used to perform a mass renormalization of a neutral scalar free field in the Hamiltonian formalism, for arbitrary space dimension. The resulting situation is analyzed by means of a Bogoliubov transformation, and seen to yield the expected results. Author

N70-23390# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Muelheim (West Germany). Inst. fuer Festigkeit.
ON THE APPLICATION OF THE KINEMATIC POLAR VECTOR DIAGRAMS TO MECHANICAL SYSTEMS WITH A FINITE NUMBER OF DEGREES OF FREEDOM [UEBER DIE ANWENDUNG DER KINEMATISCHEN PLAENE AUF MECHANISCHE SYSTEME MIT MEHREREN FREIHEITSGRADEN]
Karl Wohlhart Oct. 1969 44 p refs In GERMAN; ENGLISH summary
(DLP-FB-69-76) Avail: CFSTI

It is shown that the coefficients of the linearized equations of motion can be interpreted as moments of kinematic polar vector diagrams for a mechanical system. For a system with one degree of freedom, a dynamically equivalent pendulum, i.e. a Shukovsky-lever with a certain mass distribution, was introduced. Author (ESRO)

N70-23416# Harvard Univ., Cambridge, Mass. Dept. of Mathematics.
CLASSICAL ANALYSIS Final Report, 1 Oct. 1965 -31 May 1969
Lars V. Ahlfors 31 May 1969 8 p refs
(Contract AF 49(638)-1591)
(AD-698787; AFOSR-69-3105TR) Avail: CFSTI CSCL 12/1

This is the final report under the contract. A total of fourteen research publications and five manuscripts were prepared. These concern approximation theory, various problem areas concerning the heat equation, aspects of quasiconformal mappings and related problems. TAB

N70-23435# International Business Machines Corp., Cambridge, Mass. Federal Systems Div.
INDEPENDENT RESEARCH AND DEVELOPMENT PROGRAM, TASK NO. 0216: LAME FUNCTIONS OF THE FIRST KIND GENERATED BY COMPUTER Final Report
W. G. Walter (European Space Operations Center) Nov. 1969 62 p refs Sponsored partly by ESRO
Avail: CFSTI

The definitions of the Lame functions and the ellipsoidal coordinates inherent to them are introduced. Proceeding from Lame's differential equation, the four classes of Lame functions of the first kind are generated by computer with the aid of formula manipulation techniques. For this purpose, algebraic expressions for the coefficients in the Lame polynomials are constructed by virtue of recurrence formulas and presented in tabular as well as machine readable form for further processing. The determination of a parameter appearing in the polynomial coefficients leads to an algebraic eigenvalue problem. It is shown how this eigenvalue problem is amendable to numerical treatment. The polynomial coefficients together with the eigenvalues are characteristics for the Lame functions. Author (ESRO)

N70-23445 Tulane Univ., New Orleans, La.
WEAK HOMOTOPY CATEGORY IN A CATEGORY WITH A COTRIPLE
Sheryl Shan-hwei Cheng (Ph.D. Thesis) 1968 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-3782)

A category K with zero, kernels, and a cotriple that preserves zero objects is described. Limitations are shown for all morphisms in K and the limiting factors for an element to be weakly homotopic are given. From this, a weakly homotopic equivalence relation is derived. The weak homotopy category is then defined as the quotient category of K over the weak homotopy equivalence relation. The application of this definition to several theorems involving homology groups is shown. Dissert. Abstr.

N70-23472# Air Force Academy, Colo. Frank J. Seiler Research Lab.
CANONICAL REPRESENTATIONS OF SECOND ORDER PROCESSES WITH APPLICATIONS
Roger A. Geesey Jan. 1969 166 p refs
(AD-698765; SRL-69-0001) Avail: CFSTI CSCL 12/1

Some second order random processes are modeled in this study as the output of a causal and causally invertible linear system driven by white noise. Such a model becomes significant in considering the whitening filter techniques of Bode and Shannon for solution of the Wiener filtering problem. In the whitening filter approach, the given observation process is replaced, without loss of information, by a white-noise process; and the linear least-squares estimation problem is then easily solved in terms of the equivalent process obtained by the whitening. The causal and causally invertible model, called the canonical representation (CR), is shown to specify the whitening filter for the process. For processes that are the sum of a white noise process and a smooth process, sufficient conditions for existence of the CR are shown in terms of the existence of solution of a Wiener-Hopf integral equation. The solution for additive white noise yields the CR for a large class of differentiable processes which have an additive white noise appearing in a derivative process. Author (TAB)

N70-23480 Colorado Univ., Denver.
ON THE FORMULATION OF CONSTITUTIVE EQUATIONS
Subrata Kumar Chakrabarti (Ph.D. Thesis) 1968 121 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-4329

The restriction due to the isotropy of space is introduced into the form of a constitutive equation. Using the property of form-invariance under the principle of isotropy of space, a system of partial differential equations is deduced. A set of independent solutions is obtained by solving the system of partial differential equations. These solutions, which satisfy the principle of isotropy of space, give rise to the required invariant form of the constitutive equation. Further restrictions may be imposed by considering material symmetries. The theory as developed here applies to any form of a scalar-valued or tensor-valued constitutive equation. A dependence relationship for the solutions outside the independent set is derived and a special form of the Cayley-Hamilton theorem is obtained. The extension of this result to the most generalized Cayley-Hamilton theorem is indicated. Through the use of this last result it is possible to show how polynomial constitutive equations can be subsumed under the general theory described above. Dissert. Abstr.

N70-23485# Hawaii Univ., Honolulu. Dept. of Electrical Engineering.
A COMPUTER METHOD OF SYSTEM ANALYSIS Interim Report
Shekar Iyer Oct. 1969 7 p refs
(Contract F44620-29-C-0030)
(AD-698775; A69-7; AFOSR-69-3059TR) Avail: CFSTI CSCL 12/1

A recently developed iterative method for solving system analysis problems is discussed. The method with guaranteed convergence is considered relative to the more conventional methods. The algorithm appears to be ideally suited for a parametric family of problems and its application to frequency domain analysis is considered. Preliminary results on a computer indicate a substantial saving in time. Author (TAB)

N70-23490# National Physical Lab., Teddington (England). Div. of Numerical and Applied Mathematics.
A CATALOGUE OF HOMEOMORPHICALLY IRREDUCIBLE STAR GRAPHS WITH CYCLOMATIC NUMBER SIX
B. R. Heap Dec. 1969 39 p refs
(NPL-Ma-82) Copyright Avail: CFSTI

Star graphs are applied to problems of the statistical mechanics of interacting systems on crystal lattices using series expansions. The problem of enumerating all star graphs having a specified number of edges is considered, and it is shown that the enumeration can be considerably simplified by reducing the star graphs to simpler graphs. There are considerably fewer HI stars than stars having a specified number of vertices and edges, and once these were determined, the enumeration of a full set of stars is relatively straightforward, at least for the stars with small numbers of edges. There are a considerable number (1198) of HI stars with c = 6 and, since it is impracticable to draw them out individually a catalogue stars with c = 6 and, since it is impracticable to draw them out individually a catalogue of these graphs is given. Author (ESRO)

N70-23528*# Brown Univ., Providence, R.I. Div. of Applied Mathematics.
EXPONENTIAL ESTIMATES AND THE SADDLE POINT PROPERTY FOR NEUTRAL FUNCTIONAL DIFFERENTIAL EQUATIONS
M. A. Cruz (Philippines Univ., Quezon City) and J. K. Hale 1969 34 p refs
(Grants NGL-40-002-015; AF-AFOSR-0693A-67; DA-31-124 ARO(D)-270)
(NASA-CR-109328) Avail: CFSTI CSCL 12A

A class of equations is given for which one can estimate the norm of the linear mapping. The results are stated in terms of general functional differential equations which include differential-difference equations. An application to perturbed linear equations is indicated by discussing the saddle point property for nonlinear autonomous systems. Author

N70-23533# Indiana Univ., Bloomington. Dept. of Mathematics.
INTERNATIONAL SYMPOSIUM ON NONPARAMETRIC TECHNIQUES IN STATISTICAL INFERENCE INDIANA UNIVERSITY, 1 –6 JUNE 1969 Final Report
Madan L. Puri, ed. Dec. 1969 14 p refs
(Contract AF-AFOSR-1664-69)
(AD-698789; AFOSR-69-3058TR) Avail: CFSTI CSCL 12/1

The report contains a summary of the activities at the symposium and a list of speakers and their topics. Author (TAB)

N70-23561# Washington Univ., Seattle. Dept. of Mathematics.
ON A STATISTIC SIMILAR TO STUDENT'S t
Z. W. Birnbaum 15 Jun. 1969 14 p ref
(Contract Nonr-477(38))
(AD-698658; TR-56) Avail: CFSTI CSCL 12/1

A partial answer is given to the problem of a studentized Chebyshev inequality. Properties of S are discussed which, even in the special case of X with normal distribution, make it useful in practical situations in which Student's t is traditionally used, but in which t cannot be applied because of incomplete data, e.g. in case of one-sided or two-sided censoring. TAB

N70-23617# Princeton Univ., N.J. Dept. of Electrical Engineering.
ON HARMONIZABLE STOCHASTIC PROCESSES
Stamatis Cambanis and Bede Lin Nov. 1969 32 p refs
(Grants AF-AFOSR-1333-67; NSF GK-1439)
(AD-698767; AFOSR-69-3010TR) Avail: CFSTI CSCL 12/1

The paper presents a new orthogonal series representation and a new orthogonal integral representation for harmonizable stochastic processes. It also demonstrates the importance of harmonizable stochastic processes in systems analysis by showing that the output of a wide class of systems is a harmonizable process. Author (TAB)

N70-23642# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
SOME USEFUL GENERALIZATIONS IN MARKOV RENEWAL PROCESSES

Robert K. Wysocki (Ph.D. Thesis) 4 Nov. 1969 90 p refs
(Contract N00014-68-A-0515; Proj. Themis)
(AD-698295; THEMIS-SMU-TR-47) Avail: CFSTI CSCL 12/1

Consider a particular system which at time t may be in one of a finite number of distinguishable states, labeled for convenience by 1, 2, ..., m. Once the system enters a particular state, say i, it instantaneously selects the next state to be visited, say j, with probability P sub ij. However, transition to state j occurs after holding in state i for a random time (sojourn time) whose distribution function is F sub ij(.). These processes are known as Semi-Markov Process and the associated renewal process is called a Markov Renewal Process. In this paper a new counting process is introduced which at time t counts the number of times the system has made a one-step transition from state i to state j, i, j = 1, 2, ..., m. The matrix N(t) denotes these counts. The distribution and moments of N(t) are derived and cumulative processes associated with N(t) are discussed. The results are extended to arbitrary intervals of the form (t sub 0, (t sub 0) + t). Certain limiting results are given and some important special cases discussed. Several open problems are given in the summary chapter.
Author (TAB)

N70-23674 Purdue Univ., Lafayette, Ind.
INTERPOLATION AND APPROXIMATION BY GENERALIZED CONVEX FUNCTIONS
Hermann Georg Burchard (Ph.D. Thesis) 1968 180 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-7427

It was assumed that the equation Lu = 0 has a fundamental system of solutions which forms an extended complete Chebyshev system. These so-called "generalized convex functions" are discussed.
Dissert. Abstr.

N70-23675# Princeton Univ., N.J. Dept. of Electrical Engineering.
ON THE EXPANSION OF A BIVARIATE DISTRIBUTION AND ITS RELATIONSHIP TO THE OUTPUT OF A NONLINEARITY
Stamatis Cambanis and Bede Liu Nov. 1969 39 p refs
(Grants AF-AFOSR-1333-67; NSF GK-1439)
(AD-698768; AFOSR-69-3019TR) Avail: CFSTI CSCL 12/1

The paper considers the series expansion of a bivariate distribution and the series expansion of the output of a nonlinearity, as well as the relationship between these two problems. Three distinct expansions of bivariate distributions are presented along with a constructive procedure to obtain them explicitly. The cross-covariance property and certain results on the expansion of the output of a nonlinearity are extended to a larger class of random processes.
Author (TAB)

N70-23702# Autonetics, Anaheim, Calif.
AN INTRODUCTION TO ESTIMATION: DEVELOPMENT OF OPTIMUM ESTIMATION AS AN EXTENSION OF SIMPLE AVERAGING WITH APPLICATION TO AN INTEGRATED NAVIGATION SYSTEM
John C. Pinson Deusseldorf Deut. Ges. fuer Ortung und Navigation 1969 46 p refs Presented at the Intern. Navigation Meeting, Hamburg, 28-30 Oct. 1969
Avail: CFSTI

It is the purpose of this paper to show that the optimum estimation equations can be viewed as a rather straightforward extension of simple averaging. This is shown by working a series of examples. Each succeeding example extends the original simple averaging formula further until finally the full set of equations is obtained. The approach used is intuitive and nonrigorous. The development presented in this paper is not intended as a substitute for the statistically-rigorous derivations presented elsewhere in literature but it is intended as a supplement or another way of obtaining the same result.
Author (ESRO)

N70-23710# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory.
SUPERELLIPTIC AND RELATED COORDINATE SYSTEMS
Tove Larsen Aug. 1969 33 p refs
(R-72) Avail: CFSTI

A description is given of the construction of two-dimensional, orthogonal coordinate systems, which have superellipses as one set of parameter curves. The superellipses are constructed from Lamé curves and constitute a form, which comprises all well-known geometrical forms. The superellipse formulation is a convenient way to describe many forms by a few parameters in a clear way. The coordinate systems described are expected to be a valuable tool in the numerical solution of electromagnetic problems involving boundaries, which may be described by these sort of curves. The curves may, for example, be used in investigations of transitions between well-known types of waveguides, and in optimization procedures, where the best form of a device should be chosen among a great number of possibilities, all of which it is possible to examine by the numerical methods now available for solving electromagnetic problems. The report does not give a rigorous mathematical or geometrical treatment of the curves and their coordinate systems, but an illustrative description, which is hoped will become of value for technical applications.
Author (ESRO)

N70-23737 Tennessee Univ., Knoxville.
OSCILLATION AND DISTRIBUTION OF ZEROS OF SOLUTIONS TO NTH ORDER LINEAR DIFFERENTIAL EQUATIONS
Gary Allan Bogar (Ph.D. Thesis) 1968 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-7137

This paper is concerned with the study of oscillatory behavior of the solutions of the nth order differential equations. A Caley and Frobenius factorization of the operator is obtained. The Caley factorization then leads to the determination of the sign of the Green's function for multi-point boundary value problems and a comparison theorem that reduces to Sturm's Comparison Theorem in the second order case. It was shown that certain functions arising from two point boundary value problems are increasing and continuous. For example, it is well known that the first conjugate point is increasing and continuous.
Dissert. Abstr.

N70-23740# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON SCHEMES OF THE METHOD OF LINES OF ELEVATED ACCURACY
V. N. Abrashin 3 Apr. 1969 14 p refs Transl. into ENGLISH from Akad. Nauk BSSR, Ser. Fiz.-Mat. Nauk (Russian), no. 6, 1969 p 39-51
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Multilevel schemes of the method of lines are considered for solving some boundary value problems for parabolic, hyperbolic, and elliptic type equations. The schemes considered yield a higher order of error than earlier schemes, while the number of lines by which the initial problem is approximated does not change.
Author

N70-23741# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON UNIFORM CONVERGENCE OF DIFFERENCE SCHEMES FOR THE NEUMANN PROBLEM
V. B. Andreev 1969 15 p refs Transl. into ENGLISH from Vychislitel'naya Mat. i Mat. Fiz. (USSR), v. 9, no. 6, 1969 p 1285-1298
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Difference schemes are investigated by which the Neumann problem is approximated for the Poisson equation given in a p-dimensional rectangular parallelepiped. Emphasis is given to

obtaining a priori estimates uniform in the determinant of h for the solution of difference problems in a uniform metric. A generalized mesh Green function is the mathematical apparatus of the investigation. The a priori estimates are obtained as a consequence of the uniform boundedness of the Green function in the sense of some norms. Uniform convergence of the investigated difference schemes with a rate of the same order as that of the approximation error follows from the estimates. Author

N70-23790# California Inst. of Tech., Pasadena.
AFFINE GENERALIZED QUADRILATERALS
Marshall Hall, Jr. 1969 9 p refs
(Contract N00014-67-A-0094-0010)
(AD-698301) Avail: CFSTI CSCL 12/1

A construction is given for generalized quadrilaterals (4-gons) with s = q − 1, t = q + 1, where q = 2(e), e is greater than or equal to 2. This construction provides examples in which s and t are not a power of the same prime. Author

N70-23838# Eidgenossische Technische Hochschule, Zurich (Switzerland).
AN ALGEBRAIC CHARACTERIZATION OF RADON MEASUREMENT ON A COMPACT GROUP [UNE CARACTERISATION DE L'ALGEBRE DES MESURES DE RADON SUR UN GROUPE COMPACT]
Antoine Derighetti (Ph.D. Thesis) Oct. 1968 19 p refs In FRENCH *Its* Thesis No. 4081
Avail: CFSTI

The utilization of applicable methods in a real algebra with two topological structures of Banach and local convex spaces is considered. Emphasis is placed on algebras that are noncommutative. Theorems are proved to indicate the conditions under which the structures may exist as a compact group. Transl. by J.M.C.

N70-23840 New York Univ., N.Y.
INEQUALITIES FOR DERIVATIVES OF GREEN'S FUNCTIONS OF GENERAL COERCIVE ELLIPTIC BOUNDARY VALUE PROBLEMS
Paul Robert Zuckerman (Ph.D. Thesis) 1968 42 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-8015

A domain D in R sub n is described with G being the Green's function associated with the Dirichlet problem for Laplace's equation in D, and the boundary of the domain is assumed sufficiently regular resulting in the existence of a positive constant K. The results for all x not equal to y in the domain are given. The result is classical for n equal 2 and was established for n less than 2. The results of this work is extended to arbitrarily high order derivitives of the Green's function associated with an elliptic boundary value problem. Proofs are given for theorems involving the results for a single equation. Dissert. Abstr.

N70-23856# Connecticut Univ., Storrs. Dept. of Statistics.
SUPPLEMENT TO BIBLIOGRAPHY ON STATISTICAL ROBUSTNESS AND RELATED TOPICS Research Report
Harry O. Posten Nov. 1969 13 p refs
(Contract Nonr-3292(03))
(AD-698550; RR-46) Avail: CFSTI CSCL 12/1

In a previous bibliography, N66-84689, 252 references in the general area of statistical robustness were provided. The present paper is a supplement to this bibliography consisting of 100 additional references. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N70-22516 National Lending Library for Science and Technology, Boston Spa (England).
STATISTICAL RULES FOR SEASONAL FORECASTS AND THEIR TESTING
H. Woerner 21 Oct. 1969 29 p refs Transl. into ENGLISH from Zeit. Met. (Berlin), v. 20, 1968 p 283–293
(NLL-M-7820-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .3 NLL photocopy coupons

Simple rules are described for seasonal forecasting based on analogs and statistical deduction of the variations of weather parameters statistically relative to some other regular geophysical process such as solar activity. Observational data, relationships between sunspot cycle and geophysical processes, derivation of forecasting and analog rules, and rules from phase in sunspot cycles, and seasonal forecasting processes are evaluated. Tests on 70 random temperature and precipitation forecasts show good results for the area of Thuringia, with potential application to other regions if the corresponding long-term series of temperature and precipitation anomalies are available. E.M.C.

N70-22517 National Lending Library for Science and Technology, Boston Spa (England).
A TECHNIQUE FOR DRAWING DIGITAL CHARTS OF RADAR INFORMATION
N. F. Kotov et al 28 Nov. 1969 9 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 224, 1968 p 102–110
(NLL-M-7845-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Digital charts of the tops and bases of echo sources contain a large volume of radar information in the most concentrated form, convenient for analysis and further statistical generalizations. By comparing charts and making manual calculations, the following parameters of the cloud field can be obtained: (1) The distribution of echo sources in space and hence the type of cloud field mesostructure; (2) The configuration of echo sources, their positions in space, and the orientation of their inclination and direction of motion; (3) The configurations of echo source projections on to a horizontal plane at different heights; (4) Vertical cross sections of echo sources in the eight main cardinal directions; (5) Areas of projections in sq km and as a % of the territory considered, and the total area of projections on to a horizontal plane; (6) Total area of echo sources at different heights; (7) The volumes of particular echo sources and the total volume of sources; (8) The mean vertical thickness of echo sources for each domain, and in the whole observation zone; and (9) The time variations of these parameters, since it takes only five to fifteen minutes to obtain the given volume of radar information. Author

N70-22560# Air Weather Service, Scott AFB, Ill.
PREPARATION OF TERMINAL FORECAST WORKSHEETS Technical Report
Bryan G. Falzgraf Oct. 1969 11 p refs
(AD-698333; AWS-TR-218) Avail: CFSTI CSCL 4/2

The report discusses the importance of systematic procedures to be followed in the preparation of a terminal forecast. The use of a TAF Worksheet is recommended. The characteristics of a good worksheet are described. A review is given of the steps followed in designing a worksheet. A sample copy is given. TAB

N70-22567# Weather Bureau, Salt Lake City, Utah. Western Region.
FORECASTING MAXIMUM TEMPERATURES AT HELENA, MONTANA
David E. Olsen Oct. 1969 18 p refs
(PB-187762; ESSA-WBTM-WR-43) Avail: CFSTI CSCL 04B

Forecasting today's maximum afternoon temperature during nonadvective conditions depends primarily upon an accurate determination of net solar energy available for heating the lower atmosphere In this study an approach similar to one developed by

Williams, in which he converted net solar energy units to physical area units is used. A maximum temperature formula based upon the average number of area units for each month is developed and a nomogram in the form of a plastic overlay for use on the pseudo-adiabatic chart is constructed. Corrections for cloudiness are included on the overlay. Author (USGRDR)

N70-22590# Weather Wing (3rd), Offutt AFB, Nebr.
SYNOPTIC FEATURES ASSOCIATED WITH SNOW
Frank G. Johnson Jan. 1970 14 p refs
(AD-698835; WW-TN-70-1) Avail: CFSTI CSCL 4/2

The paper correlates wind direction to the onset of snow at Offutt AFB, NB. In addition, average 850 mb charts 0 to 11 hours antecedent to the occurrence of snow are presented. Author (TAB)

N70-22594 National Lending Library for Science and Technology, Boston Spa (England).
ON SOME PECULIARITIES OF THE FOEHN IN THE SOFIA DISTRICT
C. Capanov et al 25 Sep. 1969 6 p Transl. into ENGLISH from Hidromet. Sluz., Hidr. Met. (Sofia), v. 17, no. 5, 1968 p 47–49
(NLL-M-7783-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Radiosonde ascents made at the Sofia observatory were examined to determine cases with particularly characteristic foehn conditions. The cases studied include those in which a downward vertical velocity of at least 2 to 3 m/s was recorded and in which the pressure diagrams showed considerable deformation of the pressure curve. The results obtained through data analysis are presented and an interesting aspect involving the formation of a rotor in the lee is discussed. D.L.G.

N70-22632*# TRW Systems, Redondo Beach, Calif.
FEASIBILITY STUDY FOR REMOTE SENSING OF ATMOSPHERIC TURBULENCE PROFILES
Arthur Peskoff, Robert S. Margulies, and L. Kent Wanlass Washington NASA Mar. 1970 99 p refs
(Contract NAS12-2023)
(NASA-CR-1491; TRW-10636-6001-R0-00) Avail: CFSTI CSCL 04B

A technique was studied, based on a published mathematical result which demonstrated that the turbulence profile along the line of sight to a plane-wave light source can be calculated uniquely from an integro-differential transform of the correlation function of the logarithmic-amplitude fluctuations of light which has propagated through the turbulence. A computer program was developed, which performs the mathematical inversion transform. Numerical calculations to simulate a practical application of the technique are accomplished by applying the inversion formula to the correlation function of a delta-function turbulence profile. The spatial resolution of the inversion procedure is inversely proportional to the square of the maximum separation, and directly proportional to the square of the distance to the turbulence layer. By varying the number of terms in the summation approximation which the computer program makes for the inversion integral, the effect is simulated of varying the number of points at which the correlation function is sampled in an actual measurement. Author

N70-22643 National Lending Library for Science and Technology, Boston Spa (England).
THE USE OF SOLAR-CLIMATIC CYCLES IN SUPER-LONG-RANGE FORECASTS OF TEMPERATURE ANOMALIES
A. D. Gedeonov 28 Nov. 1969 7 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 245, 1969 p 31–34
(NLL-M-7884-(5828.4F)). Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

An eighty year climatic cycle over the Northern Hemisphere, especially in the northern latitude is discussed. January mean monthly air temperature anomalies for ten year periods since 1881 are compared. The cyclic character of these anomalies supports the prediction that over the next few years an intensification in the continental nature of the weather should be accompanied by colder winters. S.S.

N70-22658 Catholic Univ. of America, Washington, D.C.
THE IONS OF THE TROPOSPHERE: THEIR INTERACTIONS WITH AEROSOLS AND THE GEOELECTRIC FIELD
William Albert Hoppel (Ph.D. Thesis) 1969 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-8874

The problem of fair weather atmospheric electricity is two-fold. The coefficients which appear in the equations that govern the magnitude of the ion densities and the geoelectric field must be related to the microscopic properties of ions, molecules, and aerosols. The macroscopic equations must be solved with appropriate boundary conditions. The coefficients appearing in the governing equations are the recombination coefficient, the mobility, and the ion-aerosol attachment coefficients. The theoretical determination of these coefficients is discussed in detail and the results used to explain the altitude variation of electrical conductivity and the diffusional charging of aerosols by ions. The analysis is given for an improved aspiration-type mobility chamber, which suppresses the growth of boundary layers at the electrodes by employing a converging-channel geometry. The distribution of small air ions as a function of their mobility is determined from data taken with the converging channel chamber. Dissert. Abstr.

N70-22785# National Weather Records Center, Asheville, N.C.
CLIMATOLOGICAL SUMMARIES. VISIBILITIES BELOW 1/2 MILE AND CEILINGS BELOW 200 FEET. VOLUME 38: SEATTLE, WASHINGTON, TACOMA INTERNATIONAL AIRPORT Final Report
Jun. 1969 35 p
(Contract FA-67-WAI-129)
(AD-698805; FAA-RD-69-22-Vol-38) Avail: CFSTI CSCL 4/2

The report consists of climatological data for Tacoma International Airport, Seattle, Washington. Ceiling, visibility, wind, and weather information are grouped by various periods of the day and by various temperature and wind categories. Various weather and landing system categories are tabulated, in most cases from 10 years of data, as aids for making decisions affecting landing systems and fog dissipation. Author (TAB)

N70-22786# National Weather Records Center, Asheville, N.C.
CLIMATOLOGICAL SUMMARIES: VISIBILITIES BELOW 1/2 MILE AND CEILINGS BELOW 200 FEET. VOLUME 36: SALT LAKE CITY, UTAH, MUNICIPAL AIRPORT NO. 1 Final Report
Jun. 1969 35 p
(Contract FA-67-WAI-129)
(AD-698803; FAA-RD-69-22-Vol-36) Avail: CFSTI CSCL 4/2

The report consists of climatological data for Utah Municipal Airport No. 1, Salt Lake City, Utah. Ceiling, visibility, wind, and weather information are grouped by various periods of the day and by various temperature and wind categories. Various weather and landing system categories are tabulated, in most cases from 10 years of data, as aids for making decisions affecting landing systems and fog dissipation. Author (TAB)

N70-22846# Institut Royal Meteorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, Jan. 1970 [OBSERVATIONS CLIMATOLOGIQUES]
1970 15 p In FRENCH and DUTCH
Avail: CFSTI

Climatological data derived from observations made at Uccle and other meteorological stations in Belgium during January 1970 are given. ESRO

N70-22883# Air Weather Service, Scott AFB, Ill.
CATALOGUE OF LOCAL FORECAST STUDIES Indexes
Nov. 1969 242 p refs
(AD-698855; AWSP-0-13) Avail: CFSTI CSCL 4/2 Supercedes AWSP-0-13

Air Weather Service Pamphlet 0-13 is published to inform AWS activities of local forecast studies which are already available and where they may be obtained. It will assist AWS personnel who are planning newer studies by furnishing reference to earlier studies of similar nature and to studies from various locations having analogous problems. Such studies can be used effectively for planning approaches to the local problem and selecting the parameters to be used. With few exceptions, studies listed in this pamphlet are included in the master file of local forecasting studies maintained at USAF ETAC. Author (TAB)

N70-23104*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METEOROLOGICAL SATELLITE VIEWS OF CLOUD GROWTH ASSOCIATED WITH THE DEVELOPMENT OF SECONDARY CYCLONES
William E. Shenk Washington Apr. 1970 26 p refs
(NASA-TN-D-5680; G-966) Avail: CFSTI CSCL 04B

During March 1962 the cloud changes associated with the pre-development and development periods of two secondary cyclones in the North Pacific Ocean were viewed on at least two successive days by the 8-12 micron window channel of the TIROS IV meteorological satellite. Both secondary cyclones developed at the base of the occlusion. For the two cases, when the secondary circulations were first noticeable on the surface chart, the equivalent blackbody temperatures as measured by the radiometer averaged 15 K colder than the day before in the northeast quadrant relative to the base of the occlusion. The average blackbody temperature was taken over an area of approximately 300,000 square miles. For two other cases, an average warming of 4 K occurred from day to day over the same area relative to the base of the occlusion when no significant secondary development occurred and when the primary occluded cyclone was slowly weakening. These results suggest that, with the assistance of meteorological satellite radiation data, considerable cloud growth is noticeable prior to the generation of a secondary cyclone at the base of the occlusion. Author

N70-23165# Advisory Group for Aerospace Research and Development, Paris (France).
THE AERODYNAMICS OF ATMOSPHERIC SHEAR FLOW Conference Proceedings
Feb. 1970 539 p refs Mostly in ENGLISH; partly in FRENCH Presented at Fluid Dyn. Panel Specialists' Meeting, Munich, 15-17 Sep. 1969
(AGARD-CP-48) Avail: CFSTI

The conference papers presented pertain to the structure of atmospheric shear flows, basic problems related to atmospheric shear flow, and industrial problems. For individual titles, see N70-23166 through N70-23191. For the paper on 'Diffusion in the Atmospheric Surface Layer: Comparison of Similarity Theory with Observations" by W. Klug, see A69-12695.

N70-23166# Pennsylvania State Univ., University Park.
THE STRUCTURE OF ATMOSPHERIC SHEAR FLOWS: A REVIEW
H. A. Panofsky *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 14 p refs (See N70-23165 10-20)
Avail: CFSTI

Atmospheric shear flows near the ground are discussed, and characteristics of elevated shear flows not so well understood are mentioned only briefly. The behavior of the structure of atmospheric shear flows near the ground is discussed in terms of three similarity hypotheses: 1) Monin-Obukhov similarity in the surface layer, 2) Kolmogorov similarity, and 3) Davenport geometric similarity. Monim-Obukhov similarity makes it possible to combine the effects of shear and buoyancy. It describes well the wind profile in the surface layer, as well as the spectra of vertical wind and temperature, and the cospectra of heat flux and Reynolds stress. Spectra of the horizontal components do not obey Monin-Obukhov similarity, probably due to the effect of large scale roughness. Due to the high Reynolds numbers, well developed inertial subranges exist in all spectra at high frequencies, except in very stable air. In stable air, buoyant subranges agrees are observed. The inertial ranges permit estimation of dissipation. Davenport geometrical similarity predicts that the relation between wind fluctuations for given ratios of height difference and wavelength is a function of Richardson number only. This hypothesis agrees with observations at many sites. Fluctuations occur first at higher levels, then spread downwards. The delay for the lateral components is larger than for the horizontal components. Spectra of elevated shear layers (clear air turbulence) clearly show the inertial range. At lower frequencies, longitudinal rolls are indicated in the case of clear air turbulence. Author

N70-23167# Imperial Coll. of Science and Technology, London (England).
THE ORIGINS AND FORMS OF DYNAMIC INSTABILITY IN CLEAR AIR AT HIGH ALTITUDE
R. S. Scorer *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 (See N70-23165 10-20) 11 p refs
Avail: CFSTI

Observations of cloud forms, in cases where they are a reliable tracer of motions not significantly affected by latent heat, show that billows are by far the most common form of dynamic instability. Theories of instability in stratified fluids show that the Richardson number must be reduced before it can occur, and the object of this enquiry is the mechanisms which reduce Ri rather than the precise values it must take in streams with various velocity and temperature profiles before instability will occur. The mechanics of the dynamic instability show that the most likely cause is the production of a thin layer of exceptionally large vorticity by the tilting of a layer of exceptionally large static stability. The billows are unstable waves in which a vortex layer is rolled up into a row of parallel vortices, the motion temporarily looking like the well known cats' eye pattern. Initially the motion consists of the waves only but static instability soon occurs within them, and mixing by smaller scale eddies occurs. The layer then becomes thickened and well mixed with a thinner stable layer at its top and bottom. Mountain waves provide the most suitable circumstances for the tilting. Cloud layer tops and jet streams are the most probable sites for the production of the original stable layers. Author

N70-23168# Royal Aircraft Establishment, Bedford (England).
MOUNTAIN WAVES IN THE STRATOSPHERE MEASURED BY AN AIRCRAFT OVER THE WESTERN USA DURING FEBRUARY, 1967
A. Mc Pherson and J. M. Nicholls *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 (See N70-23165 10-20) 13 p refs
Avail: CFSTI

Summarized data on wave motion, and turbulence and temperature changes from nine of thirteen stratospheric flights over mountainous terrain in California, Nevada and Utah is discussed. The nature and magnitude of stratospheric disturbances and their predictability was investigated. The test aircraft, a Canberra WH 793, and test instrumentation are described. Significant turbulence is most likely in strong wave conditions at heights where there are anomalies in the vertical temperature profile. Associated with the turbulence there will probably be large and rapid changes in outside air temperature. It is fairly certain that conventional techniques of forecasting tropospheric waves also clearly estimate the severity of stratospheric waves. Even when marked stratospheric waves are likely to be present they will probably be of moderate amplitude if meteorological conditions are constant. Severe turbulence and

rapid temperature changes seem to require a combination of strong stratospheric waves and anomalies in the vertical temperature profile in the stratosphere. The indications are that neither wave amplitude nor turbulence severity depend on the magnitude of the mountainous terrain. M.H.E.

N70-23169# France. Direction de la Meteorologie Nationale, Paris).

TWO REMARKABLE EXAMPLES OF SHEAR FLOWS IN STRATOSPHERE WIND AND TEMPERATURE [DEUX REMARQUABLES EXEMPLES DE CISAILLEMENTS DANS LA STRATOSPHERE CONCERNANT LE VENT ET LA TEMPERATURE]

G. D. Barbe *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 (See N70-23165 10-20) 14 p refs In FRENCH

Avail: CFSTI

Evidence that the stratosphere is more dominated by perturbations than the troposphere is discussed. Two examples taken from the 1968 digitalized records of three triangulated sites in the vicinity of Paris are examined. In these cases, the structure of the lower and middle stratosphere presents strong and regular shear flow disturbances from the velocity and direction of the wind, the variation decreasing with altitude. Interpretation of the results is difficult and would be amendable to wave theory analysis. Canberra flights assisted in the data gathering and additional indications of extreme stratospheric changes in air and temperature are reported. Transl. by M.H.E.

N70-23170# California Univ., San Diego. Scripps Institution of Oceanography.

TURBULENCE STRUCTURE IN THE ATMOSPHERIC BOUNDARY LAYER OVER THE OPEN OCEAN

Carl H. Gibson and R. Bruce Williams *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 (See N70-23165 10-20) 11 p

(Contracts F44620-68-C-0010; Nonr-2216(23); Proj. Themis)

Avail: CFSTI

Measurements of turbulence statistics at various heights above mean sea level are described. Digital data acquisition and processing techniques were used to analyze signals from a linearized constant temperature anemometer. Mean viscous dissipation rates measured from the velocity derivative were found to be inversely proportional to the height as expected for a constant stress, neutrally stratified boundary layer. Streamwise velocity spectra exhibit extensive inertial subranges, even at scales larger than the height. probability distribution functions for the velocity difference between points separated by 1 cm are compared with lognormal predictions of Kolmogoroff and Yaglom. Author

N70-23171*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

LONGITUDINAL AND LATERAL SPECTRA OF TURBULENCE IN THE ATMOSPHERIC BOUNDARY LAYER

George H. Fichtl and George E. Mc Vehil (Cornell Aeron. Lab.) *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 20 p refs (See N70-23165 10-20)

Avail: CFSTI

An engineering spectral model of turbulence is developed with horizontal wind observations obtained at the NASA 150-meter meteorological tower at Cape Kennedy, Florida. Spectra, measured at six levels, are collapsed at each level with (nS(n)/(u sub *o) squared, f)-coordinates, where S(n) is the longitudinal or lateral spectral energy density at frequency n(Hz), u sub *o is the surface friction velocity, and f equals nz/u, u being the mean wind speed at height z. A vertical collapse of the dimensionless spectra is produced by assuming they are shape invariant in the vertical. An analysis of the logarithmic spectrum in the inertial subrange, at the 18-meter level, implies that the local mechanical and buoyant production rates of turbulent kinetic energy are balanced by the local dissipation and energy flux divergence, respectively. Author

N70-23172# Wisconsin Univ., Madison.

TURBULENCE STRUCTURE IN FLOW REGIMES OF VANISHING MEAN SHEAR

Heinz H. Lettau *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 12 p refs (See N70-23165 10-20)

(Contract DA-AMC-28-043-66-G24)

Avail: CFSTI

Classical models of turbulence assume eddy stress to be proportional to mean strain; they fail to predict eddy flux in fully developed regimes where mean shear and mean gradients vanish. Such cases occur commonly in jet-like flows for which the failure of classical models has caused literature statements on negative diffusivity or other puzzling discrepancies. Derived from basic fluid dynamics equations, an improved model assumes coupling between macro and micro eddy sizes of the turbulence spectrum. This permits consideration of conservation-and-adaption of fluid property along eddying trajectories, not only conservation as in classical models. Three dimensional structure of turbulence can now be predicted without, as well with existing mean shear, and countergradient flux can be a legitimate consequence of eddy structure. The new model is applied to selected flow cases, for which the classical theory was unsatisfactory, including the global jet-stream as well as smaller-scale circulations and also similar experimental flow, in a rectangular conduit with controlled lateral heat flux. Author

N70-23173# Hamburg Univ. (West Germany). Meteorologisches Inst.

DETERMINATION OF VERTICAL TRANSPORTS OF MOMENTUM AND HEAT AND RELATED SPECTRA OF ATMOSPHERIC TURBULENCE IN THE MARITIME BOUNDARY LAYER

L. Hasse, M. Dunckel, and D. Schriever *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 9 p refs (See N70-23165 10-20)

Avail: CFSTI

The fluctuations of temperature and of the horizontal and vertical component of wind were measured by platinum wire and hot wire anemometer at 3.5 m height above the water. From this, the vertical fluxes of heat and momentum are calculated as well as spectra and cospectra. The vertical heat flux can be shown to be nearly proportional to the product of mean wind speed and temperature difference air-sea with a transport coefficient near 0.001 and an uncertainity of 5 mcal/sq cm min. The parametrization of the vertical flux of momentum is usually done with aid of a drag coefficient. For mean conditions a value of 0.0012 is appropirate. The dependence of the drag coeffieient on the stability of density stratification is shown. Additionally, the dependence of spectra and cospectra on the stability is demonstrated. Author

N70-23174# Ludwig-Maximilians-Universitat, Munich (West Germany). Meteorologisches Inst.

MEAN WIND-PROFILE AND TURBULENCE CONSIDERATION OF A SIMPLE MODEL

Rainer Roth *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 7 p refs (See N70-23165 10-20)

Avail: CFSTI

A model is described, by which the mean vertical wind-profile and turbulence spectra at different heights are calculated for a turbulent boundary layer without thermal stratification. The model makes use of Heisenberg's formula for the transfer of turbulent energy and is based on the assumption of a constant shearing stress in that boundary layer. As a result a logarithmic wind profile follows with 0.39 as the value of von Karman's constant, which is strongly related to the inertial subrange of the turbulent energy spectra and therefore to the Kolmogoroff constant. Author

N70-23176# Ludwig-Maximilians-Universitat, Munich (West Germany). Inst. fuer Theoretische Meteorologie.

ON THE DEVELOPMENT OF CYCLONES IN A

STATIONARY LONG-WAVE BASIC STATE
J. Egger *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 11 p refs (See N70-23165 10-20)
Avail: CFSTI

In a two dimensional, quasigeostrophic two layer model, short wave perturbations are superimposed to a long-wave, stationary basic state. The shear of the basic flow is depending on x. On the western side and in the centre of the longwave trough and on the eastern side of the ridge strong developments are taking place. The western side of the ridge is a zone of damping. The influence of meridional and zonal vorticity-advection, temperature-advection and vertical velocity on the tendency of the short wave perturbations are examined. Author

N70-23176# Office National d'Etudes et des Recherches Aerospatiales, Paris (France).
AERO (HYDRO) DYNAMIC MODEL FOR CALCULATING RELIEF WAVES
Radyadour Zeytounian *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 14 p refs In FRENCH; ENGLISH summary (See N70-23165 10-20)
Avail: CFSTI

Based on the simplified equations of the Boussinesq convection theory, various theoretical models are built that may be used for studying some peculiarities of the phenomena due to the dynamic action of the relief in a barocline atmosphere, any boundary layer effect being ignored. Some results of the calculation are presented: in particular in nonlinear theory, the calculations show that downstream of obstacles a vortex regime (closed streamlines) is established, which leads in many cases to a configuration similar to that of the von Karman vortex street. This vortex regime, characterized by a strong turbulence, is responsible in a great part for the clear air turbulence phenomenon. Author

N70-23177# Colorado State Univ., Fort Collins. Coll. of Engineering.
PROBLEMS OF ATMOSPHERIC SHEAR FLOWS AND THEIR LABORATORY SIMULATION
J. E. Cermek and S. P. S. Arya *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 (See N70-23165 10-20) 18 p refs
Avail: CFSTI

Shear flows generated by movement of the atmosphere near the earth's surface are accompanied by complexities not ordinarily encountered in the treatment of turbulent boundary layers. Problems arising from the following physical features are considered: 1. thermal stratification, 2. surface roughness in the form of forests and cities, 3. nonuniformity of surface roughness and/or temperature (leading to 3 dimensional turbulent boundary layers), and 4. surface irregularities in the form of hilly and mountainous topography. The complex nature of atmospheric shear flows has stimulated efforts to study their characteristics in the laboratory under controlled conditions. Accordingly, questions of similarity between the laboratory and the atmospheric flows for both mean and turbulent quantities arise. Similarity criteria, or appropriate scaling relationships, are discussed. Wind tunnels designed for investigations related to atmospheric shear flows are described. These facilities are shown to have a capability for simulating such flows for a wide range of the physical features listed above. Author

N70-23182# Centre National De La Recherche Scientifique, Marseilles (France). Inst. de Mecanique Statistique De La Turbulence.
DESIGN OF A TUNNEL FOR ATMOSPHERE-OCEANS INTERACTIONS RESEARCH [ETUDE D'UNE SOUFFLEPIE POUR RECHERCHES SUR LES ECHANGES D'ENERGIE ATMOSPHERE-OCEANS]
M. Coantic, P. Bonmarin, B. Pouchain, and A. Favre *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 (See N70-23165 10-20) 17 p refs In FRENCH; ENGLISH summary
Avail: CFSTI

The small-scale physical mechanisms of mass, momentum and energy transfers, between the atmospheric surface layer and the oceans are considered. A critical survey of the laws governing these exchanges outlines some parameters the reproduction of which at laboratory scale will enable a partial simulation of the natural phenomena. The equipment designed is a wind-water tunnel intended to give a 40 meters long turbulent interface boundary layer, with control of: air velocity, temperature and humidity; water velocity, temperature and chemical composition; perturbulence of velocity and temperature; stratification; interface motion; tunnel walls boundary layers. A one fifth scale model is being used, to check and improve the performance and to test the measurement techniques. Author

N70-23183# Calgary Univ. (Alberta). Dept. of Mechanical Engineering.
ON THE USE OF DIFFUSING DETECTOR GASES IN THE STUDY OF ATMOSPHERIC SHEAR LAYERS WITH ADVERSE PRESSURE GRADIENTS
Joseph S. de Krasinski *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 (See N70-23165 10-20) 12 p refs
Avail: CFSTI

A theoretical study of the interrelation between the velocity field in shear layers and diffusion processes is presented, adverse pressure gradients are also included. Such interrelation is of fundamental interest in the study of shear layers and is independent of the existence of diffusion processes in natural surroundings such as air pollution. The discussion includes a variety of concentration profiles likely to be encountered. It is limited to molecular laminar processes but can be extended to turbulent ones without great difficulty. This approach should be useful for wind tunnel simulation studies. Freon 12 or 21 is suggested as the diffusing agent because it can be detected in minute quantities without affecting the flow field and because the Schmidt number of these gases diffusing in air is close to unity. During the same run of the wind tunnel a pitot tube can measure a velocity and a concentration profile giving together information which is complementary and practically impossible to obtain by other means. Preliminary experimental results are also shown in which this method was applied to trace the dividing streamline in shear layers with an adverse pressure gradient. Author

N70-23184# Meteorological Office (Gt. Brit.)
THE VERTICAL TRANSFER OF MOMENTUM THROUGH THE BOUNDARY LAYER
F. B. Smith *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 (See N70-23165 10-20) 10 p
Avail: CFSTI

The basic problem in analysing the wind profile and shearing stress profile in the atmospheric boundary layer is that insufficient soundly-based equations are available. This paper reviews some of the methods that have been adopted to close the solution, with particular reference to neutral stability conditions. A method, similar to one of those reviewed, is investigated in more detail. It is essentially an extension of von Karman's dimensional relationship between the diffusivity K and the wind profile applicable to the surface layers, extended to apply throughout the whole boundary layer by taking into account the turning of the wind. Solutions which bear a reasonable similarity with empirically determined profiles can be obtained if von Karman's constant is multiplied by a factor which is equivalent to reducing it by just over 10%. This change is in the right sense to correct for biases introduced in the derivatives by the finite difference scheme. Author

N70-23185# Technische Hochschule Darmstadt (West Germany). Dept. of Meteorology.
THE ORIENTATION OF VORTICES DUE TO INSTABILITY

OF THE EKMAN-BOUNDARY LAYER
F. Wippermann *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 (See N70-23165 01-20) 20 p refs
Avail: CFSTI

In an unstable Ekman boundary layer vortex rolls are formed; their axes are orientated almost longitudinally, they include an angle of about 14 deg to the left with the direction of the geostrophic flow. The analogy of these vortices to the Taylor-Gortler vortices on a concave wall and/or to the thermo-convective vortices due to a heated wall will be shown. Sometimes a superimposed second vortex system is observed whose axes are orientated in a more transversal direction. The spacing of these vortices is larger than that one of the more longitudinal vortices. Emphasis is placed on deriving a formula relating the forementioned angle to the ratio of the wave numbers of the two vortex systems. This formula was verified by laboratory experiments. An application of this formula to cloud streets and seif-dunes is given; the gross-features of the last ones can be explained by vortices due to Ekman layer instability. Author

N70-23186# Oregon State Univ., Corvallis.
SOME MEASUREMENTS OF INSTABILITIES AND TURBULENCE IN EKMAN BOUNDARY LAYERS
D. R. Caldwell and C. W. Van Atta (California, Univ., San Diego) *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 (See N70-23165 10-20) 16 p refs
(Grants NSF GA-849; NSF GK-1515; NSF GA-1452)
Avail: CFSTI

To simulate certain features of atmospheric and oceanic shear flows, some characteristics of rotation-dominated laminar and turbulent Ekman boundary layers were studied using hot-wire anemometry and a large rotating table. The Ekman layers are generated on two 4.3 meter diameter rotating circular plates by sucking air through the 12.7 cm wide gap between the plates into a central hub with a large blower. Beginning at Reynolds numbers (layer thickness · core speed/kinematic viscosity) of 100 or so wave-like disturbances similar to Class A (also called Type II) instabilities are observed. The spectra of these waves and their variation with height and Reynolds number are presented. Rapid increase of wave amplitude with Reynolds number was observed. As the Reynolds number is increased above 200, the general turbulence level increases until the layer becomes fully turbulent near a Reynolds number of 1000. Observations of the mean profile in the layer and turbulence spectra are presented. It is shown that profiles are logarithmic and very similar to profiles in the classical smooth plate layer. The proper scaling parameter for the spectra appears to be the Kolmogoroff scale based on the local dissipation rate. Author

N70-23187# National Physical Lab., Teddington (England).
A REVIEW OF INDUSTRIAL PROBLEMS RELATED TO ATMOSPHERIC SHEAR FLOWS
C. Scruton *In* AGARD Aerodyn. of Atmospheric Shear Flows Feb. 1970 (See N70-23165 10-20) 20 p refs
Avail: CFSTI

The non-aeronautical problems related to atmospheric shear flows are broadly divided into those of the effects of the airflow itself on environmental conditions and those of the effects of the airflow on structures immersed in it. The first category includes wind shelter, smoke dispersal and air pollution, and the flow of wind in and around building complexes. By far the most important problems in the second category relate to the design of structures against the loadings due to wind. For many buildings and structures consideration of the time-averaged wind loads is sufficient but with the modern tendency towards more slender and lighter structures using methods of fabrication which produce less structural damping, they have become more prone to respond to the unsteady wind loading which arises either directly from the fluctuations of wind force due to the turbulence of atmospheric shear flows or to the inherent aerodynamic instability of the structure. The important properties of atmospheric winds in the above problems are the variation of the wind speed and direction with height, and the characteristics of the turbulence and their dependence on height. These properties vary with the terrain over which the wind flows and with the strength of the wind. Some of the effects of the speed profiles and of the turbulence of atmospheric shear flows on smoke dispersal and wind loading are briefly discussed. Author

N70-23351# Ludwig-Maximilians-Universitat, Munich (West Germany). Meteorologisches Inst.
SPECTRAL VARIANCE ANALYSIS OF LONG-PERIOD CLIMATOLOGICAL SERIES [SPEKTRALE VARIANZANALYSE KLIMATOLOGISCHER REIHEN IM LANGPERIODISCHEN BEREICH]
Christian-Dietrich Schoenwiese Jan. 1969 84 p refs In GERMAN *Its* Wissenschaftliche Mitteilungen no. 15
Avail: CFSTI

Long-term variations of climatological factors were investigated using appropriate methods of variance and power spectrum analysis. Historical data were also included. After outlining the mathematical method of analysis including Fourier analysis and power spectra, the possibility of using tree rings as climate indicators is discussed. However, it was difficult to establish a definite correlation between tree growth and specific parameters. Terrestrial and extra-terrestrial causes for these variations are also discussed. ESRO

N70-23378# National Weather Records Center, Ashville, N.C.
CLIMATOLOGICAL SUMMARIES: VISIBILITIES BELOW 1/2 MILE AND CEILINGS BELOW 200 FEET. VOLUME 37: SAN FRANCISCO, CALIFORNIA, INTERNATIONAL AIRPORT Final Report
Jun. 1969 35 p
(FAA Order FA-67-WAI-129)
(AD-698804; FAA-RD-69-22-Vol-37) Avail: CFSTI CSCL 4/2

The report consists of climatological data for San Francisco International Airport, San Francisco, California. Ceiling, visibility, wind, and weather information are grouped by various periods of the day and by various temperature and wind categories. Various weather and landing system categories are tabulated, in most cases from 10 years of data, as aids for making decisions affecting landing systems and fog dissipation. Author (TAB)

N70-23384# Institut Royal Meteorologique de Belgique, Brussels. Inst. d'Hygiene et d'Epidemiologie.
ATMOSPHERIC POLLUTION, SMOKE AND SULFUR DIOXIDE Monthly Bulletin, Jun. 1969 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULTUREUX]
1969 23 p In FRENCH and DUTCH
Avail: CFSTI

Tables are given of sulfur dioxide and smoke quantity (air pollution) measured at different weather stations in Belgium in June 1969. A brief description is given of the air sampling apparatus. ESRO

N70-23385# Institut Royal Meteorologique de Belgique, Brussels. Inst. d'Hygiene et d'Epidemiologie.
ATMOSPHERIC POLLUTION, SMOKE AND SULFUR DIOXIDE Monthly Bulletin, Jul. 1969 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX]
1969 24 p In FRENCH and DUTCH
Avail: CFSTI

Tables are given of sulfur dioxide and smoke quantity (air pollution) measured at different weather stations in Belgium in July 1969. A brief description is given of the air sampling apparatus. ESRO

N70-23414# Honeywell, Inc., St. Paul, Minn. Research Dept.
SPINNING-WIRE DENSIMETER DEVELOPMENT Final Report, 17 Oct. 1968 – 31 Aug. 1969

Lyle E. Koehler and Stephen F. Rohrbough Nov. 1969 112 p refs
(Contract F19628-67-C-0087)
(AD-698347; Honeywell-12050-FR1; AFCRL-69-0373) Avail: CFSTI CSCL 4/2

Analytical studies indicate that the Spinning-Wire Densimeter approach to density measurement is viable. The sensor consists of a wire drag element with a solar-sensor-modulated miniature 1680-MHz transmitter located at its center. A rotation rate of approximately 1000 rad/sec is given to the sensor as it nears the rockets apogee. It is then ejected and allowed to free fall. Its spindown rate is a measure of atmospheric density. Error analyses show that, with a receiver output signal-to-noise ratio of 60 db, the maximum density error with the present sensor design is about 30 percent for a 450,000-foot apogee and about 3 percent with a 400,000-foot apogee. Gyroscopic righting effects, electric field and plasma sheath effects do not produce significant torques on the sensor. However, an additional error results if no correction is made for dimensional variations. Author (TAB)

N70-23439# Denver Research Inst., Colo.
EXPERIMENTAL DESIGN AND SATISTICAL EVALUATION OF WEATHER MODIFICATION EXPERIMENTS Final Report, 1 Apr. 1967 – 1 Sep. 1969
P. J. Stinson 15 Sep. 1969 108 p refs Sponsored by Atmospheric Water Resources
(PB-186523) Avail: CFSTI CSCL 04B

The general objective was to develop experimental design criteria and statistical methods to evaluate the attainments of the Atmospheric Water Resources Programs. In order to achieve this general objective, accomplishments in four specific objectives or methods of procedure were pursued: critical evaluations of past weather modification experiments, special analyses and studies, development of design criteria for field experiments, and the development of statistical computer programs and analytical techniques. Author (USGRDR)

N70-23666# Technische Hochschule, Darmstadt (West Germany). Inst. fuer Meteorologie.
RELATION BETWEEN LAGRANGE AND EULER CORRELATION FUNCTIONS [ZUR BEZIEHUNG ZWISCHEN LAGRANGESCHEN UND EULERSCHEN KORRELATIONSFUNKTIONEN]
H. W. Franz 30 Nov. 1968 57 p refs In GERMAN
(Contracts WI-150/8 and WI-150/9)
Avail: CFSTI

Based on a turbulence model which uses the Navier-Stokes equations, and also considers time variations of the turbulence to a first approximation, two systems each with three integral equations were established for the Lagrange and Euler correlation functions. These integral equations include three distribution functions which connect the two types of correlation functions and have to be eliminated. In isotropic turbulence such a connection exists between the longitudinal and the lateral Euler correlation functions. Two methods are given for eliminating these unknown distribution functions and also determining the two unknown constants. ESRO

N70-23762# Weather Bureau, Silver Spring, Md. Systems Development Office.
ANALYSIS OF CLEAR AIR TURBULENCE FROM RAWINSONDE ASCENSIONAL RATES
Mary W. Hodge, Harold B. Cole, and DeVer Colson Sep. 1969 31 p refs
(Contract FA-68-WAI-137)
(FAA-RD-69-52) Avail: CFSTI

Intensity and frequency of clear air turbulence increases as an acceleration variable of the rawinsonde observation, defined as adjusted acceleration, increases. Adjusted acceleration represents the magnitude of the rawinsonde acceleration without respect to sign which has been adjusted, by regression techniques, for a small dependence upon the average rate of ascent for that observation. This acceleration variable is used to describe large scale variations in rawinsonde ascensional rates. Equations for estimated turbulence probabilities as a function of adjusted acceleration were obtained for three ten-day collection periods. The scatter of the data was large, and the reductions of variance for all acceleration predictors were too small for the equations to be of practical use as an indicator of turbulence. Probabilities of turbulence occurrence are computed using the one most consistent set of these equations. These are compared with percent occurrences of turbulence from a fourth collection period. Accurate predictions and misses occurred with almost equal frequency. Author

N70-23833# Ludwig-Maximilians-Universitat, Munich (West Germany). Meteorologisches Inst.
INVESTIGATIONS OF HEAT BALANCE OF THE EARTH'S SURFACE AND OF ATMOSPHERIC HEAT TRANSPORT NEAR THE GROUND [UNTERSUCHUNGEN ZUM WAERMEHAUSHALT DER ERDOBERFLAECHE UND ZUM BODENNAHEN ATMOSPHAERISCHEN TRANSPORT]
Gerhard Berz Jul. 1969 101 p refs In GERMAN
(MITT-16) Avail: CFSTI

The heat balance for an entire year was measured with the research reactor of the Munich meteorological station and computed with an IBM 7090. A separate investigation of the temperature profile in the lowest 20 cm of the air layer near the ground and in the grass layer formed a link with the extrapolation of the surface temperature from the profile of the ground temperature and gave connections to the radiation temperature of the surface. Temperature fluctuation spectra were derived from temperature measurements in several air layers near the ground. The energy spectra of global thermal currents and gradients in the frequency range .000103 Hz were also investigated. ESRO

N70-23873# Technische Hochschule Darmstadt (West Germany). Inst. fuer Meteorologie.
PREDICTION METHOD BASED ON THE THEORY OF STATIONARY TIME SERIES APPLIED TO THE PREDICTION OF TURBULENT WIND COMPONENTS, PART 1 [DAS VORHERSAGEVERFAHREN DER THEORIE STATIONAERER ZEITREINEN ANGEWANDT AUF DIE VORHERSAGE TURBULENTER WINDKOMPONENTEN, 2. TEIL]
E. Grimm and W. Klug 1 Mar. 1969 27 p refs In GERMAN
(Contract T-748-i-203)
Avail: CFSTI

It is shown that the application of prediction methods derived from the theory of stationary random functions and applied to turbulent wind velocity values leads to good results. Given the observed values and the turbulence spectrum, the prediction over a time interval has a mean error, that amounts to 55–80% of the scattering of the observed series and therefore gives a real improvement compared to the prediction of the mean value. Prediction over a time interval of a few minutes should now be possible. ESRO

N70-23879# Institut Royal Meteorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, Sep. 1969 [OBSERVATIONS CLIMATOLOGIQUES 1969 16 p In FRENCH and DUTCH
Avail: CFSTI

Climatological observations performed in Belgium during September 1969 are listed giving daily values of maximum and minimum temperatures, duration and intensity of sun radiation, magnetic variations and beta radioactivity. ESRO

N70-23886# Utah Univ., Salt Lake City.
AN INVESTIGATION OF THE PREDICTION AND

STABILITY OF RADIATION FOG Final Report, Jun. 1968 –Jul. 1969
Wilford G. Zdunkowski, Devon Mecham, and David C. Trask Sep. 1969 119 p refs
(Contract DAEA18-68-C-0213)
(AD-699364; ECOM-0213-F) Avail: CFSTI CSCL 4/2

The prediction of the nocturnal temperature profile in the absence of fog; radiative transfer in a cloud. TAB

N70-23891# Pennsylvania State Univ., University Park.
WIND PROFILES, SPECTRA, AND CROSS-SPECTRA OVER HOMOGENEOUS TERRAIN Final Report, 1 Jun. 1965 –31 May 1968
Alfred K. Blackadar and Hans A. Panofsky 30 Jun. 1969 80 p refs
(Contract DA-28-043-AMC-01388)
(AD-699365; ECOM-01388-3) Avail: CFSTI CSCL 4/2

Cospectra and quadrature spectra of wind components observed simultaneously at two levels are most easily predicted by using the coherence and the eddy slope. Analysis of White Sands data confirms the hypothesis that the latter quantities are simply related to the Richardson number. A theory is presented that makes possible the prediction of one dimensional spectra up to wavelengths several times the height. A test of the theory at White Sands gave good results. The logical basis for the similarity theory of the flow in the planetary boundary layer is examined in detail. The scaling principles developed here are applied to momentum exchange and verified tentatively by analysis of a composite set of wind observations at ONeill, Nebraska. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N70-22621*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
A NEW CONCEPT IN STRAPDOWN INERTIAL NAVIGATION
John E. Bortz, Sr. Washington Mar. 1970 228 p refs
(NASA-TR-R-329; C-93) Avail: CFSTI CSCL 17G

In conventional strapdown inertial navigation systems, the coordinate transformation matrix differential equation is integrated in the computer of the system. This computation typically requires 30 to 60 percent of the time budget of the computer. A method is presented for significantly reducing the digital computation burden through the use of hybrid computational techniques. Analog correction signals for the non-commutativity phenomenon are fed onto the gyro torque generators causing the gyros to integrate a vector differential equation in the rotation vector argument of the coordinate transformation matrix. The coordinate transformation matrix is then merely evaluated as a matrix function of the rotation vector argument. A 20 to 1 reduction in the digital computer time budget can thus be realized. Author

N70-22831# Royal Aircraft Establishment, Farnborough (England).
A HIGH ACCURACY FINE SUN SENSOR
A. K. Brookman Jul. 1969 29 p refs
(RAE-TR-69157) Copyright. Avail: CFSTI

Design and constructional details are given for a sensor suitable for fine guidance of sun-pointing space vehicles. Factors affecting the accuracy and stability of the sensor are discussed and optimum values for certain critical parameters are suggested for Skylark and satellite applications. Bias error measurement methods are described and it is concluded that, because of atmospheric turbulence, results using the real sun are unreliable; an alternative method using a solar simulator is presented which has given results repeatable to about 2 arc sec. The sensor accuracy achieved is compared with the sensor-to-experiment alignment accuracy likely to be realized in practice and it is suggested that where pointing errors less than about 10 arc sec are required, the experiment should include an integral ultrafine guidance sensor. Author (ESRO)

N70-22863*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT CONTROL
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 128 – 150 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 17G

Guidance and control problems investigated cover: (1) laboratory test results on strapdown navigation system employing three digital velocimeters and two electrically suspended gyros for inertial reference; (2) electronic design of digital gyro system for intertial sensor; (3) algorithm for approximating nonlinear filtering problem; (4) performance tests on speed sensor and optimal controller for minimum energy controller; (5) evaluation of strapdown electrically suspended gyroscope as life-long inertial reference for spacecraft attitude control; (6) design of automatic laser obstacle detector for lunar or planetary roving vehicle; (7) production of animated 16 mm silent film depicting the motion of Mariner 4 spacecraft during days following depletion of its attitude control gas; and (8) electronic circuitry for use in the thermoelectric outer planet spacecraft single-axis air-bearing table demonstration. G.G.

N70-22908*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
REACTION CONTROL SYSTEM DESIGN
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 19 p refs (See N70-22901 10-31)
Avail: CFSTI CSCL 17G

The baseline reaction control system (RCS) of N2H4 monopropellant is compared with three alternate RCS concepts of bipropellant, cold N2 gas, and a resistojet. An N2H4 monopropellant propulsion system was chosen because of the impulse requirements of the RCS. The RCS of the attitude control system provides for spin-up, despin, attitude control, and orientation maneuvers required of the satellite. The thrusters and engine for use in the RCS system are described in detail. R.B.

N70-22911*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ATTITUDE SENSING AND CONTROL SYSTEM
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 81 p refs (See N70-22901 10-31)
Avail: CFSTI

Basic mission guidelines and spacecraft constraints affecting the design of the attitude sensing and control system (ASCS) consist of experimental pointing and control accuracies, power and thermal constraints, spacecraft configuration, and spacecraft operational mode requirements. The approximate physical locations and orientations of the baseline ASCS components are illustrated. These components include various sensors, actuators, and the flywheel. The signal processing system and operation of the ASCS are described. Author

N70-22920*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
REACTION CONTROL SYSTEMS AND KICK STAGE ANALYSES, APPENDIX G
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 34 p refs (See N70-22901 10-31)
Avail: CFSTI CSCL 17G

Two alternate attitude control systems considered for the baseline HEAO are discussed and compared. A summary and comparison of all alternate RCS concepts considered for the baseline

HEAO are also included. A detailed analysis of an apogee kick stage for use on the HEAO to increase the Titan 3D launch vehicle payload is presented. Author

N70-22923*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ATTITUDE SENSING AND CONTROL SYSTEM, APPENDIX J
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 118 p refs (See N70-22901 10-31)
Avail: CFSTI CSCL 17G

Alternate system configurations are considered for the various sensors on the spacecraft, including a star mapper, digital sun sensor, and an earth horizon scanner. The sizes of the magnetic torquers for the HEAO spacecraft are determined and described. The torquers are designed for scan-axis attitude orientation and scan-rate control. An alternate celestial pointing mode and several reference coordinate systems are discussed. The rotational motion of the spacecraft is solved by using Euler equations of motion. Control laws for attitude and scan-rate control of the spacecraft are summarized. A magnetic field model with a magnetic dipole set along the earth's geomagnetic axis is used to simulate the HEAO control system. Aerodynamic force and moment coefficients were calculated on the assumption of free molecular flow and diffuse reflection. Alternate spacecraft performance simulations are considered for baseline configurations with and without a spinning flywheel and with and without attitude control. R.B.

N70-23026# Advisory Group for Aerospace Research and Development, Paris (France).
ADVANCED CONTROL SYSTEM CONCEPTS Conference Proceedings
Jan. 1970 324 p refs Mostly in ENGLISH; partly in FRENCH
AGARD Conf. held at Oslo, 3-5 Sep. 1968
(AGARD-CP-58) Avail: CFSTI

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N70-23027# Autonetics, Anaheim, Calif.
SURVEY OF ADAPTIVE CONTROL APPLICATIONS TO AEROSPACE VEHICLES
Richard K. Smyth and Harold L. Ehlers *In* AGARD Advanced Control System Concepts Jan. 1970 p 1-12 refs (See N70-23026 1 -21)
Avail: CFSTI

Adaptive systems applied to aerospace vehicles are classified as (1) providing a closed loop control system with uniform stability and handling qualities over the complete flight envelope, even though the open loop characteristics of the vehicle undergo drastic changes; and (2) providing acceptable flying qualities over a wide range of external disturbances due to atmospheric turbulence and outer loop command signals. Adaptive system objectives are reviewed including compensation for vehicle dynamic variation and input signal variations. Vehicle dynamics are summarized, emphasizing natural frequency variations of body bending modes and open loop short period dynamic response. Aspects of self-adaptive control systems are described, along with their patent issues. J.A.M.

N70-23031# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
FLY-BY-WIRE FLIGHT CONTROL SYSTEMS
J. P. Sutherland *In* AGARD Advanced Control System Concepts Jan. 1970 p 49-72 refs (See N70-23026 10-21)
Avail: CFSTI

An outline of the philosophy of fly-by-wire flight control systems is given, the evolution of fly-by-wire is discussed, the advantages over mechanical systems are listed, current techniques are outlined, and a brief review of the Air Force Flight Dynamics Laboratory proposed in-house and contracted fly-by-wire development programs is given. Author

N70-23032# Elliott Bros., Ltd., London (England). Airborne Display Div.
THE IMPACT OF ELECTRONIC DISPLAYS ON AIRCRAFT CONTROL
Peter Lowry *In* AGARD Advanced Control System Concepts Jan. 1970 p 73-85 (See N70-23026 10-21)
Avail: CFSTI

Display devices are reviewed, emphasizing head up and head down displays and their components. Each device was

proposed for use in aircraft, but all, except the cathode ray tube, will require more development before regular use in cockpit displays. J.A.M.

N70-23033# Smiths Industries, Ltd., Cheltenham (England). Aviation Div.

THE PLACE OF ADAPTIVE CONTROL TECHNIQUES IN THE FUTURE DEVELOPMENT OF AUTOMATIC FLIGHT CONTROL SYSTEMS

A. J. Dymock, K. A. Helps, and J. F. Meredith *In* AGARD Advanced Control System Concepts Jan. 1970 p 87–100 refs (See N70-23026 10-21)

Avail: CFSTI

A system identification procedure which could form the basis of an adaptive flight control system is described. Problems of multiplexing such a system in order to achieve adequate reliability are discussed. Author

N70-23034# Societe Francaise d'Equipments pour la Navigation Aerienne, Neuilly-sur-Siene (France).

ADAPTABLE COMMAND SYSTEMS [SYSTEMES A COMMANDE ADAPTABLE]

B. Hamel *In* AGARD Advanced Control System Concepts Jan. 1970 p 101–111 refs In FRENCH (See N70-23026 10-21)

Avail: CFSTI

Self adaptive systems for good stability control and transitory responses in flight are discussed. Different devices for automatic pilot control are given. Laboratory tests were performed to determine the effectiveness of the self adaptable damping devices in detection of frequency oscillations and in a para-linear SFENA type 166. It is shown that effective control can be obtained without the use of special test signals. Transl. by J.M.C.

N70-23035# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.

ADAPTIVE CONTROL OF FLEXIBLE AIRCRAFT STRUCTURAL MODES

Robert P. Johannes *In* AGARD Advanced Control System Concepts Jan. 1970 p 113–120 (See N70-23026 10-21)

Avail: CFSTI

The load alleviation and mode stabilization flight control was developed to minimize problems in structural flexibility. The primary control techniques used were multiple sensor blending and appropriate filtering. Sensor blending provided the intelligence to control the structural and rigid body motions while notch and high frequency filtering was used as required to eliminate unwanted feedback signals. Author

N70-23036# Bendix Corp., Southfield, Mich. Electromagnetics Systems Lab.

A RESPONSE REGULATION TECHNIQUE FOR SELF-ADAPTIVE CONTROL OF FLEXIBLE AIRCRAFT

R. B. Hollstien and W. H. Gruber *In* AGARD Advanced Control System Concepts Jan. 1970 p 121–138 refs (See N70-23026 10-21)

(Contract F33615-67-C-1404)

Avail: CFSTI

A self-adaptive system is described for longitudinal control of a flexible aircraft whose response characteristics vary to such an extent over the flight envelope that fixed parameter control systems are inadequate. A prescribed invariant response is obtained by imbedding the airframe in an internal feedback subsystem with variable controller gains. The subsystem is then controlled by a fixed parameter control law, and the response of the complete system is regulated using a model reference adaptive adjustment of the subsystem controller gains. The general procedure for computation of the multivariable control law is described. The performance of a simulated system using a simple second-order control law and two airframe normal bending modes is presented for various pilot inputs and aerodynamic disturbances at three diverse flight conditions. Author

N70-23037*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT TEST EXPERIENCE WITH ADAPTIVE CONTROL SYSTEMS

Milton O. Thompson and James R. Welsh *In* AGARD Advanced Control System Concepts Jan. 1970 p 139–147 (See N70-23026 10-21)

Avail: CFSTI

Our flight experience and some general pilot reactions to the adaptive features are summarized. Some unexpected occurrences are described that identify areas of required improvements if the adaptive feature is to be used in future systems. Author

N70-23038# Royal Aircraft Establishment, Farnborough (England).

SELF-ADAPTIVE MANOEUVRE DEMAND CONTROL SYSTEMS: SOME PRACTICAL DESIGN CONSIDERATIONS

G. C. Howell and G. T. Shanks *In* AGARD Advanced Control System Concepts Jan. 1970 p 149–168 ref (See N70-23026 10-21)

Avail: CFSTI

Two types of self-adaptive systems were simulated with particular application to the gain computation for the pitch rate system of the aircraft. The simulation included a full representation of the aircraft and its control system including nonlinearities such as the rate limit of the first stage actuator. The two types considered are: (1) A predictive system based on sampled data but with a continuous rather than a sampled data inner loop; and (2) A development of the Whitaker type of analogue model reference system. To overcome the non-linear effect of the adaptive gain with input amplitude, and the asymmetry of the adaptive gain in this application, the system was perturbed by a test signal so that the adaptive process was at, or very close to, its optimum value at all time. The effects of wind turbulence and sensor noise on the performance of the adaptive systems are discussed. Both systems are stable or can be made to be stable with little decrease in performance when perturbed by either type of noise. Author

N70-23040# Royal Aircraft Establishment, Bedford (England). Blind Landing Experimental Unit.

SAFETY RELIABILITY FOR ALL-WEATHER LANDING SYSTEMS

O.B. St. John *In* AGARD Advanced Control System Concepts Jan 1970 p 183–191 (See N70-23026 10-21)

Avail: CFSTI

Advanced automatic landing systems in civil aviation history are summarized, and safety criterion are established for this all-weather operation. Most of the experimental work was performed with redundant equipment, and this was compared with complex equipment and found superior in reliability. The need for a pilot even while using automatic flight control is evaluated. J.A.M.

N70-23094# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CIVIL AVIATION PILOT AND NAVIGATOR HANDBOOK

G. V. Markov et al 20 Mar. 1969 366 p Transl. into ENGLISH of the book "Spravochnik Pilota i Shturmana Grazhdanskoi Aviatsii Moscow, Transport, 1967 p 1–368

(AD-693277; FTD-HT-23-488-68) Avail: CFSTI CSCL 17/7

The manual is intended for pilots and navigators in civil aviation. It can also be used by workers of civil aviation maintenance, by military-transport flight crews, and by students of intermediate and advanced aviation training schools. In the handbook is given material on the technical aspects of flight and geometrical data on Soviet civil aircraft, on the aerodynamics of high-speed aircraft,

means of aircraft control, aviation meteorology, cartography, and astronomy. In it are also presented several mathematical computations which are necessary to the flight crew. The book contains various data needed by the pilot and navigator to accomplish any type of flight and in any meteorological conditions, both day and night, and before as well as during the flight. Author (TAB)

N70-23099*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A COMPUTER PROGRAM FOR RAY TRACE THROUGH SPACECRAFT WINDOWS

Kenneth C. White Washington Apr. 1970 33 p refs
(NASA-TM-X-1983; A-3456) Avail: CFSTI CSCL 17G

A FORTRAN IV computer program has been written specifically for tracing rays through spacecraft windows. The program computes the window-induced angular deviation of the rays from their original path. Any type of window may be considered with no restriction on size, shape, material, or number of panes. The necessary equations are written in vector matrix form for mathematical convenience and ease in computation. The program requires mathematical models of each window surface. The numerical procedures used are described and a test case is presented. Author

N70-23350# Technische Univ., Berlin (West Germany). Inst. fuer Flugfuehrung und Luftverkehr.

STAR SENSORS FOR AERONAUTICS AND ASTRONAUTICS [UEBER STERNSENSOREN FUER LUFT- UND RAUMFAHRT]

E. Roessger, R. Priebs, H. Wolff, H.-U. Gellinger, and A. Leutz Jul. 1969 163 p refs In GERMAN
(Rept-49) Avail: CFSTI

All types of star sensors, especially those applicable to inertial navigation systems are surveyed. The principles of star sensors with mechanical modulation devices (rotating disks) and of electronic star sensors, such as quadrant photomultiplier tubes, vidicons, and orthicons are summarized. The use of star sensors for inertial platforms is also discussed. ESRO

N70-23393# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).

RESEARCH IN "FLUGFUEHRUNG"

K. H. Doetsch *In* AGARD 5th AGARD Ann. Meeting Sep. 1969 p 13–22 (See N70-23391 10-34)
Avail: CFSTI

The organization of the Institut fur Flugfuehrung is outlined, and two examples of research work are discussed. The term flugfuehrung is defined as the determination of the flight path of a flying object and its guidance along that path. A quickened display device is described which displays necessary control data on a cathode ray tube for an aircraft pilot, replacing many separate dials. Initial test results with the display device are considered to be encouraging. The second project is concerned with developing electronic digital transmission of control signals to replace mechanical controls on aircraft. All elements with a chance failure structure are assembled into compact replaceable units, and the rest of the system contains elements with a failure behavior characteristic of mechanical control devices. N.E.N.

N70-23418*# National Aeronautics and Space Administration, Washington, D.C.

SPACECRAFT GRAVITATIONAL TORQUES: NASA SPACE VEHICLE DESIGN CRITERIA (GUIDANCE AND CONTROL)

May 1969 51 p refs
(NASA-SP-8024) Avail: CFSTI CSCL 17G

A state-of-the-art review of design procedures considering gravitational torque effects and recommended torque analysis practices are discussed. The gravitational torque equation is given, and inertial dyadic and gyroscopic terms are included. It is pointed out that the gravitational distrubance torques should be analyzed in the early design phase, and the recommended practice considers the radius vector, spacecraft mass properties, spacecraft orientation, instantaneous torque, and torque impulse. Means of controlling the gravitational torques are described for spin-stabilized satellites, three-axis actively stabilized spacecraft, and a spacecraft with extended structures. The derivation of the gravitational torque equation for a rigid body, and the determination of torque and angular impulse are also given. N.E.N.

N70-23421# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

ANALYSIS OF AN INTEGRATED INERTIAL/DOPPLER-SATELLITE NAVIGATION SYSTEM. Part 1: THEORY AND MATHEMATICAL MODEL Technical Report

R. Grover Brown Dec. 1969 70 p refs
(Contract N00014-68-A-0162)
(AD-698293; ERI-62600) Avail: CFSTI CSCL 17/7

Inertial navigation systems have reached a high level of sophistication in recent years, but the effect of long-term-drift is still a problem in many applications. It has been demonstrated that position fixes obtained from the Navy Navigation Satellite System may be used to update an inertial system, but simple position updating can not correct the underlying causes of the drift nor can it correct the Schuler oscillation in the undamped case. This report describes a method of system integration whereby the Doppler data is treated directly as the observable in a Kalman-filter reset scheme. The advantage of this approach is that estimates of the inertial velocity and gyro bias errors are obtained as well as the position errors. Thus, the additional information obtained from the Kalman filter can be used to reduce the rate of error propagation in the interim between passes. Details of the Kalman filter model are presented in the report. Author (TAB)

N70-23501# Advisory Group for Aerospace Research and Development, Paris (France).

HYBRID NAVIGATION SYSTEMS Conference Proceedings

Jan. 1970 293 p refs Mostly in ENGLISH; partly in FRENCH Presented at Guidance and Control Panel 9th Meeting, Delft, Neth., 22-26 Sep. 1969
(AGARD-CP-54) Avail: CFSTI

Outlined are current technologies for hybrid guidance and control systems in aircraft and satellite navigation. Considered are systems applications in air traffic control and landing approaches as well as theoretical aspects of airborne and ground elements in hybrid techniques. For individual titles, see N70-23502 through N70-23522.

N70-23502# Collins Radio Co., Cedar Rapids, Iowa.

HYBRID SYSTEMS FOR GUIDANCE AND NAVIGATION

G. R. Marner *In* AGARD Hybrid Navigation Systems Jan. 1970 12 p refs (See N70-23501 10-21)
Avail: CFSTI

Developments in sensors, computers, data transmission techniques and systems theory have greatly accelerated the trend toward hybrid guidance and navigation systems. Operational needs for new types of data, for accuracy and reliability, and for multi-mode operation to complete missions despite failure or lack of input data have motivated this trend. General comments concerning the characteristics of redundant, complementary and synergistic systems are made, and a list of important hybrid system examples is given. Operational needs for some future hybrid systems are outlined. These include areas of aircraft landing, navigation and traffic control, marine navigation and traffic control and space navigation. Author

N70-23503# Aerospace Corp., El Segundo, Calif.

CHARACTERISTICS OF A SATELLITE NAVIGATION SYSTEM OPERATED IN CONJUNCTION WITH A USER

INERTIAL SYSTEM
B. P. Leonard and J. B. Woodford *In* AGARD Hybrid Navigation Systems Jan. 1970 9 p (See N70-23501 10-21)
Avail: CFSTI

A hybrid satellite/inertial navigation system can provide virtually all of the desirable features for a navigation system. Used together, they provide great precision. If necessary, either can be used separately, providing redundancy. Finally, the inertial system provides greater performance if initialized by the satellite system rather than by conventional methods. Author

N70-23504# Radio Corp. of America, Princeton, N.J. Defense Electronic Products.
A GLOBAL NAVIGATION/TRAFFIC SURVEILLANCE/COMMUNICATION SATELLITE SYSTEM FOR MILITARY AND CIVIL VEHICLES
Michael W. Mitchell *In* AGARD Hybrid Navigation Systems Jan. 1970 18 p refs (See N70-23501 10-21)
Avail: CFSTI

The speed, position and track system simultaneously provides precise position and velocity determinations of vehicles on or near the surface of the earth and data communications between these vehicles and remotely located ground stations. By employing specially formatted RF signals, the same RF channels provide passive (self) navigation services to users in line of sight of the satellites, and traffic surveillance and data transfer between cooperative users and ground control centers. The system is composed of: (1) ground control stations where the RF signals are generated and transmitted to satellites, and return signals are processed for traffic surveillance, data transfer and synchronization purposes; (2) a network of synchronous satellites which relay RF signals from the ground stations to a field of users and back; and (3) the user instrumentation where the navigation and data signals are processed for a position fix, and/or transponded back through the satellites to the ground control station for traffic surveillance purposes. Analyses and tradeoffs of system error sources and equipment requirements indicated that the RF band between 1000 and 3000 MHz offered a good choice for carrier frequencies. Author

N70-23505# Royal Aircraft Establishment, Farnborough (England).
THE TMA ROLE OF HYBRID-SYSTEM RADIO SENSORS
F. S. Stringer *In* AGARD Hybrid Navigation Systems Jan. 1970 (See N70-23501 10-21) 8 p
Copyright. Avail: CFSTI

In time the whole of Europe and North America may need to be considered as terminal areas for the purpose of navigation. The ultimate accuracy to aim for will be that necessary to ensure that an aircraft can join the approach guidance system unaided by ground radar. If high reliability and sufficient accuracy is provided by the airborne system, then the ground radar role can be reduced to one of monitoring, with consequent alleviation of high workload upon the ground radar operators. The same stringent reliability and accuracy requirements should be demanded over areas where navigation rather than traffic separation is the prime requirement. There is therefore strong incentive to examine the provision of an area coverage lattice radio sensor which will give good coverage (preferably world wide) at all altitudes, with an accuracy of about + or − 1/4n. mile (2.S.D.) by day and by night, in all conventional and VTOL types of aircraft. This sensor should be coupled with the DR components by an appropriate technique such as Kalman filtering or a modified form of it. Author

N70-23506# Decca Navigator Co., Ltd., London (England).
THE USE OF FILTERING TECHNIQUES AND/OR MIXED NAVIGATION SYSTEMS IN COMBINATION WITH BAROMETRIC ALTIMETRY TO GENERATE GLIDE SLOPES FOR PRECISION APPROACH
M. G. Pearson *In* AGARD Hybrid Navigation Systems Jan. 1970 15 p refs (See N70-23501 10-21)
Avail: CFSTI

The paper describes an airborne navigation system, based on the Omnitrac digital computer, which incorporates a technique for the provision of profile guidance. The system combines a means for determining accurate position fixing in the horizontal plane, with a vertical guidance facility utilising barometric input and the resultant data is lined with the aircraft flight system. The requirements and problems involved in handling data from a variety of station referenced and/or self-contained navigation sensor are considered, as are the techniques employed in the data filtering and mixing processes. Filtering in this context implies digital signal processing or the application of statistical techniques to the navigation sensors utilised. The basis for both the filtering and the mixing processes is the formulation of a prediction vector, produced from previously computed wind vectors and true airspeed for a single sensor system, or computed by a Doppler/Inertial mix when this is used in conjunction with a radio position fixing sensor such as Decca, Loran, VOR/DME. Profile guidance is obtained by comparison between the achieved glide path, (computed from the ground speed vector derived from the navigation sensors, and the rate of ascent or descent from successive differences of the barometric altimeter) and the required glide path. Author

N70-23507# Royal Aircraft Establishment, Bedford (England). Blind Landing Experiment Unit.
THE USE OF INERTIAL INFORMATION TO IMPROVE AUTOMATIC ILS APPROACH PERFORMANCE
N. H. Hughes *In* AGARD Hybrid Navigation Systems Jan. 1970 (See N70-23501 10-21) 14 p
Avail: CFSTI

In this paper, the kinds of noise and interference which can occur on the ILS localizer signal received in an aircraft approaching to land are reviewed. The problems of designing an approach coupler which is insensitive to localizer noise and interference are described. Criteria for an acceptable design of coupler are defined and it is shown that these criteria can be met if information from a high quality inertial navigation system is used to complement the ILS localizer deviation signal. Results are shown of flight evaluation of an ILS-inertial system with and without interference on the localizer signal. The possibilities of improving the system design through the use of optimim filtering techniques are briefly discussed. Author

N70-23508# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
IMPROVEMENT OF THE ACCURACY OF AUTOMATIC LANDING SYSTEMS BY USE OF KALMAN-FILTERING-TECHNIQUES AND INCORPORATION OF INERTIAL DATA
W. Schmidt et al *In* AGARD Hybrid Navigation Systems Jan. 1970 19 p refs (See N70-23501 10-21)
Avail: CFSTI

This paper deals with the investigation of the terminal approach and landing of a jet fighter with an automatic landing system. It is assumed that only the longitudinal motion must be considered. At first an optimization of the autopilot is carried out by solving the deterministic control problem using dynamic programming. The optimal feed back gains are obtained by minimizing a quadratic performance criterion. The accuracy of the landing is essentially influenced by effects of aerodynamic, ILS and radar altimeter disturbances. As the ILS respectively the radar altimeter noise is the dominant factor reducing the accuracy of landing emphasis is put to the filter problem of estimating the state variables. Hereby two methods are employed: (1) the incorporation of IMU-Data; and (2) the introduction of Kalman-Filters. Author

N70-23509# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
COLLISION AVOIDANCE AND THE AIR TRAFFIC CONTROL ENVIRONMENT
Anatole Browde *In* AGARD Hybrid Navigation Systems Jan.

1970 (See N70-23501 10-21) 13 p refs
Avail: CFSTI

Discussed is the operation of a collision avoidance system designed to provide air-to-air information exchange between aircraft, and provide safe separation under all weather conditions, even in dense terminal aera traffic. The technology used is a time ordered, either ground or other aircraft resynchronized system, in which range, range rate and altitude is used to develop threat parameters. Also discussed will be the behavior of this type of a system in the post-1975 air traffic control environment, as derived by simulation. Growth options arising from the collision avoidance system include a system of precisely identifying and locating aircraft as an air traffic control tool. Postulated growth additions can provide air-to-air station keeping, trilateration techniques to enable precise location of the aircraft for ground control, and also precise navigation by the pilot with respect to the ground, without either voice communication or the requirement of encoding aircraft position on digital air-to-ground data links. This technique can also be used for terminal area approach and can be extended to Category I landings. Inherent in the Collision Avoidance System is the ability to exchange up to 150 bits of binary data every three seconds. Author

N70-23510# Singer-General Precision, Inc., Wayne, N.J.
INTEGRATED HYBRID-INERTIAL AIRCRAFT NAVIGATION SYSTEMS
B. Danik and R. C. Stow *In* AGARD Hybrid Navigation Systems Jan. 1970 (See N70-23501 10-21) 27 p refs
Avail: CFSTI

Multi-sensor hybrid inertial navigation systems are discussed from a design and performance point of view. Candidate systems are configured from Doppler, Omega, Loran, stellar, navigation satellite, and inertial sensor subsystems. In each case the self-contained inertial platform is augmented with one or more of the sensor aids. In order to maximize the useful information content from noisy sensor outputs optimum quasi-linear statistical filtering is applied to the system mechanization. The assumed sensor error budgets reflect a spectrum of hardware. In-flight alignment and calibration of various hybrid-inertial sensor combinations is demonstrated by digital simulation with emphasis on flight trajectory correlations to total navigation system performance. Doppler and inertial sensor error estimation is presented as an example of in-flight calibration techniques. Assessments made in this paper reflect some of the experience factors gained from hardware as well as software mechanization development. Author

N70-23511# Autonetics, Downey, Calif.
MODERN AIRCRAFT NAVIGATION SENSORS FOR HYBRID SYSTEMS
W. R. Fried *In* AGARD Hybrid Navigation Systems Jan. 1970 21 p refs (See N70-23501 10-21)
Avail: CFSTI

Presented are basic principles, design characteristics and performance trends, of the four modern navigation sensors which make up typical hybrid systems, namely Doppler radar, inertial measuring units, ground-based radio systems and airborne radar. The mathematics underlying the combination of these dead reckoning and position fixing sensor outputs to form a hybrid system which generates the "most probable" position is introduced. The most significant modern Doppler radar characteristics are described, notably three-dimensional velocity determination by means of fixed antennas and various techniques for obtaining accurate over-water operation. Design trends, a typical error model and performance trends are presented. Significant design trends, a typical error model and performance trends of inertial measuring units are given. The fundamental characteristics, limitations, and implementation trends of the modern point-source and hyperbolic ground-based radio systems are analyzed and compared. The use of airborne radar for semi-automatic position fixing is described and the limitations of conventional airborne radars are highlighted. The basic principles of the more modern, synthetic aperture and squint mode radar are described and its excellent resolution performance behavior is discussed. The mechanization of a Doppler-inertial-radio multisensor system is presented, with a possible physical configuration, indicating the feasibility of extremely small, hybrid navigation systems of this type. Author

N70-23512# Air Force Systems Command, Andrews AFB, Md. Interlaboratory Technology Div.
LORAN SYSTEM TECHNOLOGY
Russell E. Weaver, Jr. *In* AGARD Hybrid Navigation Systems Jan. 1970 12 p refs (See N70-23501 10-21)
Avail: CFSTI

Presented to a background introduction of hyperbolic radio aids from its inception to the present day. Initial uses and and limitations will be discussed. From this, we will proceed into a basic description of Loran transmitters and receivers which outlines chain configurations, chain coverage, receiver types and control/display capabilities. The paper will then delve primarily into applications which are envisioned as a result of recent technology advances. A front runner among these various applications is the use of Loran as a hybrid navigation system. Although each individual navigation sensor in existence has certain inherent limitations, most, if not all of these, can be successfully overcome by the appropriate integration of these sensors into a common system. Additionally, a number of applications in which Loran can be effectively and profitably used commercially are presented to stimulate planners and programmers. Author

N70-23513# Societe d'Applications Generales d'Electricite et de Mecanique, Paris (France).
HYBRID OPTIMAL INERTIAL NAVIGATION SYSTEM [SYSTEME DE NAVIGATION A INERTIE HYBRIDE OPTIMISE]
P. Faurre *In* AGARD Hybrid Navigation Systems Jan. 1970 17 p refs In FRENCH (See N70-23501 10-21)
Avail: CFSTI

The principles of utilizing an optimal inertial navigation system with a plate form, as that of velocity and intermediate position measurements, are outlined. The performance of the system and the possibility of using such a system in actual flight are assessed. The relationship of these problems to the sensitivity and the numerical mechanization of the digital filter are also outlined. Transl. by J.M.C.

N70-23514# Air Force Systems Command, Wright-Patterson AFB, Ohio. LORAN Programs Office.
TACTICAL LORAN
Lloyd D. Higginbotham *In* AGARD Hybrid Navigation Systems Jan. 1970 13 p (See N70-23501 10-21)
Avail: CFSTI

Reviewed are efforts to develop a military capability in LORAN. Briefly described is a tactical LORAN system and its advantages and disadvantages as a common user grid system. Since LORAN is a relatively low data rate system, emphasis is being given to the problems encountered when integrating the system into high performance aircraft. It describes the various methods of integration and the relative accuracies to be expected of each. It also includes the environmental aspects such as signal to noise ratios as affected by aircraft attitude, phase inversions and precipitation static noise. A status report is given on hardware technology and where this technology is leading in terms of weight, volume and cost. To overcome some of these limitations it is shown that simple retransmitting devices can satisfy many projected requirements for position locating by remotely processing the received signals. Author

N70-23515# Northrop Corp., Hawthorne, Calif. Electronics Div.
THE C-S NAVIGATION SYSTEM: AN APPLICATION OF DIGITAL SYNERGISTIC STOCHASTIC HYBRID NAVIGATION TECHNOLOGY

Bruce J. Miller *In* AGARD Hybrid Navigation Systems Jan. 1970 21 p refs (See N70-23501 10-21)
Avail: CFSTI

The C-5 Navigation System is built around a high speed general purpose digital computer which receives navigation signals from an inertial measurement unit (IMU), doppler radar, loran receiver, tacan receiver, magnetic gyro compass, air data computer, multi-mode radar, and manually entered visual position and stellar fixes from the control and indicator panels. A large number of steering and navigation modes are available which make use of a number of sensor combinations. This paper describes the system, tracks the technical approach and application of theory to the development of the mechanization, and presents predicted performance results generated via digital computer simulations.
Author

N70-23516# Elliot Flight Automation, Ltd., Borehamwood (England). Inertial Navigation Div.
THE HYBRID NAVIGATION SYSTEM FOR THE NIMROD MARITIME PATROL AIRCRAFT
R. P. G. Collinson *In* AGARD Hybrid Navigation Systems Jan. 1970 13 p (See N70-23501 10-21)
Avail: CFSTI

The Hawker Siddeley NIMROD is the latest maritime patrol aircraft about to enter service with the R.A.F. and will replace the Hawker Siddeley Shackelton. It is a development of the very well proven Hawker Siddeley Comet jet air liner and it is propelled by four Rolls Royce Spey by-pass jet engines, giving it a long range, high speed cruise capability -- in fact, the Nimrod will be the fastest maritime patrol aircraft in service in the Western world. It is also able to operate with two engines shut down for the slow speed search mode and possesses excellent handling throughout its speed range. The Nimrod is fitted with very advanced avionic equipment, including a digital navigation and tactical computer which drives a sophisticated display system.
Author

N70-23517# Air Transport Association of America, Washington, D.C.
THE USE OF HYBRID NAVIGATION TECHNIQUES IN COMMERCIAL TRANSPORT AVIATION
Siegbert B. Poritzky *In* AGARD Hybrid Navigation Systems Jan. 1970 6 p (See N70-23501 10-21)
Avail: CFSTI

This introduction of inertial systems, and the prospect for satellite systems may bring a quite unique form of hybrid operation into the airline fleet. Some aspects of this form of hybrid operation are discussed. A form of hybridization may come as a by-product of the inertial navigation capability since the inertial system provides not only navigation, but more fundamentally, provides very good basic heading and attitude sensors for the aircraft. Thus for the first time, a single system provides a series of essential functions -- navigation, heading, attitude and accelerations. They permit rationalization and smoothing of other navigation sensors which may be more accurate but sometimes less consistent. One important use of inertial information will come in the augmentation of ground signal-based automatic approach and landing guidance systems. Here high-quality inertial data will come to be used to smooth ILS signals and overcome some of the effects of windshear and gusts. Hybridization may also permit the use of an outer-loop monitor crosscheck of various airplane systems, and could form the basis for a common multilateration type navigation and surveillance system -- once again in a way which can provide the advantages of hybridization without the disadvantage of inter-dependence.
Author

N70-23519# Technische Hochschule Stuttgart (West Germany). Inst. fuer Flugnavigation.
INTEGRATED NAVIGATION BY LEAST SQUARE ADJUSTMENT
K. Ramsayer *In* AGARD Hybrid Navigation Systems Jan. 1970 (See N70-23501 10-21) 11 p refs
Avail: CFSTI

The usual way of combining different navigational aids by a human navigator has the disadvantage that the available navigational informations are utilized only very imperfectly. The efficiency can be improved essentially by combining the different navigational aids by an airborne general purpose computer in such a way, that we get an integrated navigation system, which makes optimum use of the navigational informations. For this purpose the following way is proposed: The basic navigational system is a dead reckoning system (DRS). This can be a Doppler or inertial navigator or a classic dead reckoning system, which determines the flight path from true airspeed and wind. The other navigational aids serve for control measurements, with the help of which we determine by least square adjustment during the flight the error of the dead reckoning position and the most important systematic error sources of DRS. The supplementary navigational aids are consequently used both for the correction of the DR-position and for the calibration of the DR-system.
Author

N70-23520# Ferranti, Ltd., Manchester (England).
A SIMPLE KALMAN FILTER FOR VOR/DME
M. A. V. Matthews *In* AGARD Hybrid Navigation Systems Jan. 1970 (See N70-23501 10-21) 10 p refs
Avail: CFSTI

Any commercial aircraft will carry some means of dead reckoning navigation, such as compass/air data, compass/Doppler or inertial navigation. It is therefore feasible to mix dead reckoning inputs with VOR/DME in a Kalman filter as a means of reducing the deficiencies of VOR/DME on its won. A computer simulation of such a system has been mounted with the object of investigating the effectiveness of a Kalman filter in this application. The filter has been kept simple, having only four elements in its state vector. The present filter would be most suitable for use with compass and Doppler; it would also be suitable for use with inertial velocity inputs for short periods of time. It is intended also to simulate a modified version of the filter in which the velocity and heading biases are replaced by northings and eastings wind components. This would be suitable for use with air data and compass. The simulation programme is designed to assess the operation of the filter in determining present position taking account of the following factors: (1) position of Beacon relative to flight path; (2) use of VOR or DME alone; (3) erroneous assessment of error statistics in filter design; (4) effect of further simplification of filter; and (5) effectiveness of filter in trimming heading and velocity biases for use in subsequent dead reckoning.
Author

N70-23521# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
OPTIMAL CORRECTION OF STOCHASTIC ERRORS OF AN INERTIAL NAVIGATION SYSTEM: Simulation Studies
R. Swik and G. Schmidt *In* AGARD Hybrid Navigation Systems Jan. 1970 (See N70-23501 10-21) 12 p refs
Avail: CFSTI

Discussed is the application of a Kalman-Bucy Filter to the updating process of an inertial navigation system. Noisy position measurements from a LORAN-receiver are utilized as a reference signal for updating the inertial system. After each piece of measurement is taken, the optimal estimates from the filter are used for error corrections. During this process these estimates are treated as representative of the unavailable exact values of the system errors. One special advantage of this method is that all modeled errors are estimated and corrected from the position fixes. The concept has been evaluated by digital simulation of the navigation system and the computer, as well as the digital filtering and correcting scheme.
Author

N70-23622*# Massachusetts Univ., Amherst.
DESIGN OF LOW SENSITIVITY KALMAN FILTERS FOR HYBRID NAVIGATION SYSTEMS
C. E. Hutchinson and J. A. D'Appolito (Anal. Sci. Corp., Reading, Mass.) *In* AGARD Hybrid Navigation Systems Jan. 1970 (See N70-23501 10-21) 7 p refs
(Grant NGR-22-010-12)
Avail: CFSTI CSCL 17G

An expressed goal of any hybrid navigation system is the desire to achieve better overall performance for the total system acting in concert than would be possible if each component system acted independently. One technique for obtaining optimum overall performance that has been proposed is the use of Kalman filters. However, the Kalman technique has some very crucial disadvantages. One specific disadvantage is the prerequisite requirement for knowing the exact statistical description for each random signal inherent in the navigation system. Seldom is this data known exactly and it is necessary, therefore, that the Kalman filter be designed in the presence of this uncertainty in system specification knowing in advance that true optimum performance will not be achieved. This paper presents a design procedure applicable to this situation. A mathematical formulation of the design procedure using game-theoretic ideas (min-max) is given. Several results are presented which greatly simplify some of the computer algorithms needed for actual design techniques, and an example of specific navigation system usage is presented. Author

N70-23578# Technische Hochschule Stuttgart (West Germany). Inst. fuer Flugnavigation.
AUTOMATIC CORRECTION OF A DOPPLER NAVIGATION SYSTEM BY COMPENSATION OF CONTROL MEASUREMENTS WITH AUXILIARY NAVIGATION AIDS [AUTOMATISCHE KORREKTUR EINER DOPPLERNAVIGATIONSANLAGE DURCH AUSGLEICHUNG VON KONTROLLMESSUNGEN MIT ZUSAETZLICHEN NAVIGATIONSHILFSMITTELN]
K. Ramsayer Mar. 1969 38 p refs In GERMAN; ENGLISH summary
Avail: CFSTI

A Dead-Reckoning system (DR) (Doppler, inertial navigator, classical) to determine the flight path, with the other aids serving as control measurements, to give the errors by a least squares method, is considered. One method determines the coordinates of the present position in the DR coordinate system by the supplementary navigational aids. These control coordinates are compared with the coordinates of the DR-position and the resulting differences, caused by DR errors and those of the control coordinates, are described by observation equations, which take into account the most important DR systematic errors. All other errors are assumed to be random corrections. In another method quantities corresponding to the control measurements (e.g. distances, bearings) are computed for the present DR position and observation equations are derived from the difference between the measured and computed quantities. The latter method is more flexible because single control measurements can be used and weights can be introduced. Both methods are applied to the integration of TACAN with a Doppler navigator and changing error parameters are also considered. Author (ESRO)

N70-23595# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
THE EFFECT OF DRIFT FROM RECIPROCAL PERPENDICULARITY OF RING AXES ON KINEMATICS OF FOUR-RING GYROSCOPE CARDAN SUSPENSION [INFLUENCE DES DEFAUTS DE PERPENDICULARITE ENTRE LES AXES DES ANNEAUX SUR LA CINEMATIQUE D'UNE SUSPENSION DE GYROSCOPES A QUATRE ANNEAUX]
G. D. Ananov et al [1969] 14 p ref Transl. into FRENCH from Izv. Vyssh. Ucheb. Zaved. Priborostr. (Leningrad), no. 12, 1968 p 81-86 In FRENCH and RUSSIAN
(LBRA-69-0730) Avail: CFSTI

A combined graphic and analytic approach is used to investigate the kinematics and effects on instrument accuracy of a gyroscope gimbal system. Transl. by E.C.

N70-23623# Aztec School of Languages, Inc., Maynard, Mass.
STABILITY CONDITIONS OF THE GRAVITATIONAL STABILIZATION SYSTEM OF SATELLITES WITH GYROSCOPIC DAMPING [USLOVIYA USTOYCHIVOSTI SISTEMY GRAVITATSIONNOY STABILIZATSII SPUTNIKOV S GIRODEMPFIROVANIYE]
V. A. Sarychev Jan. 1970 24 p refs Transl. into ENGLISH from Astron. Acta (Russian), v. 14, 1969 p 299-310 Prepared for Lincoln Lab., MIT
(AZT-70-143-RULL) Avail: CFSTI

The general equations of motion of a satellite with two secondary gyroscopes are presented. The action of gravitational and aerodynamic moments is taken into account. Several positions of the gyroscopes in relation to the frame of the satellite are examined. Then the necessary and sufficient conditions for asymptotic stability of the equilibrium positions of the satellite gyroscope system are derived. Author

N70-23628# Aztec School of Languages, Inc., Acton, Mass. Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE STABILITY OF A SINGLE-AXIS GYROSTABILIZER IN THE PRESENCE OF DRY FRICTION IN THE AXIS OF STABILIZATION [OB USTOYCHIVOSTI ODNOOSNOGO GIROSTABILIZATORA PRI NALICHII SUKHOGO TRENIYA V OSI STABILIZATSII]
N. Ya. Kogan Dec. 1969 10 p refs Transl. into ENGLISH from Priborostroyeniye (Russian), v. 12, no. 3, 1969 p 79-84 Prepared for Lincoln Lab., MIT.
(AZT-70-40-RULL) Avail: CFSTI

The stability of a single-axis gyrostabilizer is investigated taking into account the moment of dry friction in the axis of stabilization for those cases when the gyrostabilizer without friction is stable and neutral. It is demonstrated that a great number of equilibrium states are asymptotically stable on the whole. Author

N70-23672# Deutsche Gesellschaft fuer Ortung und Navigation e. V., Duesseldorf (West Germany).
THE NAVY SHIPBOARD NAVIGATION SATELLITE SYSTEM
Harold M. Nordenberg 1969 17 p refs Presented at the Intern. Navigation Meeting, Hamburg, 28-30 Oct. 1969
Avail: CFSTI

The Navy Navigation Satellite System is a world-wide all-weather system that enables a ship's navigator to obtain accurate navigational fixes from data collected during a single pass of an orbiting satellite. Descriptions are given for the four satellites, four tracking stations, two injection stations, the US Naval Observatory work, a computing center, and the shipboard equipment. ESRO

N70-23728# Deutsche Gesellschaft fuer Ortung und Navigation e. V., Duesseldorf (West Germany).
INTRODUCTION: USER PROBLEMS
Hans-Christian Freiesleben 1969 8 p refs Presented at the Inter. Navigation Meeting, Hamburg, 28-30 Oct. 1969
Avail: CFSTI

A general introduction to the influence of wave propagation factors, the accuracy of position fixing of aircraft and ships is given. Very low frequency equipment and the problems encountered in their use are also discussed. ESRO

N70-23729# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
AZIMUTHAL DRIFT OF DIRECTIONAL GYROSCOPE SPIN AXIS MOUNTED ON INCLINED BASE [DERIVE

AZIMUTALE D'UN GYROSCOPE MONTE SUR UN SUPPORT INCLINE]
Yu. F. Lazarev [1969] 11 p Transl. into FRENCH from Izv. Kievsk. Politekhn. Inst. (Kiev), no. 12, 1968 p 66–70 In FRENCH and RUSSIAN
(LRBA-69-0728) Avail: CFSTI

Simplified equations of motion are derived to show that a spin axis directional gyroscope mounted on an inclined base exhibits a systematic azimuthal drift. In the general case, the drift occurs when there is a constant component of the moment of external force effective with respect to the outside gimbal axis. A condition is described in which the velocity of the systematic drift is maximum. Transl. by E.C.

N70-23803# Decca Navigator Co., Ltd., London (England).
FLIGHT TEST OF OPERATION OF LORAN C [FLUEGERPROBUNG DES BETRIEBSVERHALTENS VON LORAN C]
W. Blanchard Duesseldorf Deut. Ges. fuer Ortung und Navigation 1969 21 p refs In GERMAN Presented at the Inter. Navigation Meeting, Hamburg, 28-30 Oct. 1969
Avail: CFSTI

Propagation observations of the LORAN C navigation system using a DECCA ADL 21 receiver onboard an aircraft revealed the following reception deterioration problems due to the use of low frequencies: (a) interrelation of ground-wave and sky-wave depending on geographical location; (b) effect of the ground conductivity on signal strength; (c) influence of atmospheric disturbances such as corona and lightning; (d) effect of other transmitters. It was concluded that there is a need for far-reaching research on propagation conditions at low frequencies using the LORAN C system which might lead to a review of current ideas on wave attenuation, etc. ESRO

N70-23808# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
APPLICATION OF KALMAN FILTERING TO APOLLO PROGRAM [ANWENDUNG DER KALMAN-FILTERUNG AUF DAS APOLLO-PROGRAMM]
Richard H. Battin and Gerald M. Levine Duesseldorf Deut. Ges. fuer Ortung und Navigation 1969 53 p refs In GERMAN Presented at the Intern. Navigation Meeting, Hamburg, 28-30 Oct. 1969
Avail: CFSTI

This report deals with the followig topics: a) navigation near celestial bodies; b) extrapolation of the state vector and the fault matrix; c) insertion of measured data; d) command module navigation in cislunar space; e) command module navigation during rendezvous; f) navigation of the lunar module during rendezvous; g) command module navigation in orbit; h) flight experiences with the Apollo navigation system. ESRO

N70-23814# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).
PREDETERMINATION OF RELIABILITY CHARACTERISTICS FOR INERTIAL NAVIGATION SYSTEMS AND POSSIBILITIES FOR IMPROVEMENT OF RELIABILITY [UEBER DIE VORAUSBERECHNUNG VON ZUVERLAESSIEKEITSKENNWERTEN FUER TRAEGHEITSNAVIGATIONSSYSTEME UND MOEGLICHKEITEN ZUR VERBESSERUNG DER ZUVERLAESSIGKEIT]
H. Heusmann 1969 24 p In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

Starting from the definition of mission success, for which the accuracy and the reliability of an inertial navigation system are critical, the calculation of the mean time between failure (MTBF) and of the characteristics for a self-testing device are indicated. The influence of system accuracy on mission success is also discussed. After detailed consideration of the possibilities of improving reliability some examples are given for the construction of the electronic equipment, the self-testing device and the system lay-out. ESRO

N70-23827# Deutsche Gesellschaft fuer Ortung und Navigation e.V., Duesseldorf (West Germany).
USER PROBLEMS: FREQUENCIES ABOVE 10 MHZ
J. Filz 1969 11 p Presented at the Intern. Navigation Meeting, Hamburg, 28-30 Oct. 1969
Avail: CFSTI

Aircraft navigation and landing systems as well as clear air turbulence warning systems using frequencies higher than 10 MHz are discussed from the point of view of the users. ESRO

N70-23830# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
PROJECT ASTRID: DEVELOPMENT OF A STABILIZATION SYSTEM FOR STELLAR ORIENTED ROCKET PAYLOADS [PROJEKT ASTRID: ENTWICKLUNG EINES STABILISIERUNGSSYSTEMS FUER STERNORIENTIERTE RAKETENNUTZLASTEN]
H. W. Killian 11 Sep. 1969 18 p In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

A description is given of a axis stabilization system, ASTRID, for high altitude research rockets which orients the scientific measuring devices towards a desired stellar object. The ASTRID was conceived for a Centaur payload with a spin rate of 6 revolutions/sec. Its task after separation of motor and payload will be to direct the optical axis of the experiment on to a star in the Orion constellation. The angle between the optical axis and the line of sight of the star is approximately 30 deg. Within a minute this inclination has to be reduced to less than 5 minutes of arc, so that the experiment can begin. ESRO

N70-23843# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
THE STABILITY OF A SINGLE AXIS GYROSTABILIZER IN THE PRESENCE OF DRY FRICTION IN THE AXIS OF PRECESSION [OB USTOYCHIVOSTI ODNOOSNOGO GIROSTABILIZATORA PRI NALICKII SUKHOGO TRENIYA V OSI PRETESSII]
N. Ya. Kogan Oct. 1969 11 p refs Transl. into ENGLISH from Priborostroenie (Moscow), v. 11, no. 12, 1968 p 59–65 Prepared for Lincoln Lab., MIT
(AZT-69-646-RULL) Avail: CFSTI

A single axis gyrostabilizer is studied, allowing for the moment of dry friction in the axis of precession for the cases when the gyrostabilizer without friction is stable and neutral. It is shown that all movements of the gyrostabilizer asymptotically approach uniform rotational motions around the axis of stabilization. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N70-22822# Babcock and Wilcox Co., Lynchburg, Va. Power Generation Div.
THE 1000-MWe LMFBR FOLLOW-ON STUDY, TASK 2 AND 3. VOLUME 2: CONCEPTUAL SYSTEM DESIGN DESCRIPTIONS (SECTIONS 1-7) Final Report
Mar. 1969 556 p refs Prepared for ANL
(BAW-1328-Vol-2) Avail: CFSTI

Conceptual design parameters for a 1000 MW(e) LMFBR are presented. Systems described include: land and structures; reactor vessel; shielding; core; control elements and drive circuits; cooling system; and auxiliary and maintenance equipment. NSA

N70-22524 National Lending Library for Science and Technology, Boston Spa (England).
THE RADIATION FACTOR IN THE PRODUCTION AND USE OF KRYPTON AND XENON
N. V. Vershinin et al 21 Nov. 1969 12 p refs Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniya (Moscow), v. 11, Apr. 1967 p 42–44 In ENGLISH and RUSSIAN
(NLL-WINDSCALE-Trans-416-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Radiation factor levels in an inspected industrial plant producing a krypton xenon mixture were inspected. The method of producing krypton and xenon predetermines the accumulation of radon. Reduction of radon contamination of the air in krypton production rooms is accomplished by: (1) storage of the cylinders for 10 to 15 days before delivery; (2) ensuring a fivefold change of air in the rooms containing the cylinders; (3) hermetic sealing of the pipelines and vessels containing the krypton; (4) limitation of the number of freshly filled cylinders. Equations represent the rate of accumulation of radon in the rooms. S.S.

N70-22592# Los Alamos Scientific Lab., N.Mex.
SHORT-LIVED DELAYED GAMMA-RAY EMISSION FROM FAST FISSION OF PLUTONIUM
Billy M. Moore Sep. 1969 79 p refs
(Contract W-7405-eng-36)
(LA-4257) Avail: CFSTI

The short-lived delayed gamma spectra from fast neutron fission of plutonium was experimentally measured by using a Ge(Li) detector. The half-lives and energies of the more prominent gamma rays in the spectra were determined for half-lives in the range 1 min < or = to t sub 1/2 < or = to 60 min and for energies in the range 170 keV < or = to E < or = to 1800 keV. From the delayed gamma spectra, yields were determined for the short-lived fission products: Rb-89, Rb-90, Sr-94, Y-94, Mo-101, Tc-101, Sb-131, Xe-135m, I-136, Xe-137, Xe-138, and Cs-138. Minimum estimates of the yields were determined for Y-95, Tc-104, Xe-139, Cs-140 and Ce-145. Also, the delayed gamma spectra from fast fission of Pu-239 was compared to that obtained from fast fission of U-235. From the results obtained conclusions could be reached on what fission products would produce the largest differences in the two spectra at high energy. Author (NSA)

N70-22869 Carnegie-Mellon Univ., Pittsburgh, Pa.
NONLINEAR SPATIAL STABILITY BY AN EXTENSION OF LIAPUNOV'S DIRECT METHOD WITH APPLICATION TO COUPLED FAST REACTOR SYSTEMS
Dahsoong Yue (Ph.D. Thesis) 1969 259 p
Avail: Univ. Microfilms: HC $11.70/Microfilm $3.35 Order No. 69-6690

Methods of functional analysis and theories of partial differential equations are used to extend Liapunov's direct method to the spatial stability of the general nonlinear autonomous and non-autonomous operator equations. To ensure stability, the operators have to be dissipative operators which are the infinitesimal generators of equi-bounded semigroups for parabolic equations and groups for hyperbolic equations. In order to apply the stability theorems to partial differential equations, the operators must be extended to be defined in a complete normed linear space. The important requirement is that the space of differentiable functions be complete, i.e., that the operator, its domain and its range are defined in such a way that all required formal mathematical operations are valid within the setting of the space. this is done by introducing generalized derivatives and Sobolev spaces. Dissert. Abstr.

N70-22707# Argonne National Lab., Ill.
FAULT PROPAGATION IN AN EBR-2 MARK-2 DRIVER FUEL SUBASSEMBLY
A. V. Campise Mar. 1969 69 p refs
(Contract W-31-109-eng-38)
(ANL-7560) Avail: CFSTI

The consequences of cladding failures in a Mark 2 EBR 2 experimental fuel element were evaluated under steady state power. The principal consequences considered were the blanketing of adjacent fuel elements in a fuel subassembly with fission gas and the interactions of Na and molten fuel following a partial loss of Na bond in a fuel element. The possibility of fault propagation was evaluated based on physical properties of the Mark 2 driver-fuel subassembly and the EBR 2 reactor core. The results indicate an extremely low probability for propagation of faults in fuel elements due to gas blanketing or rapid formation of Na vapor resulting from interaction of Na and molten fuel. Upper limit conditions for fault propagation are shown to be restricted to an area of thermohydrodynamic combined-system values that indicate an extremely low probability of occurrence. Author (NSA)

N70-22803# Atomics International, Canoga Park, Calif.
LARGE RADIOISOTOPE HEAT SOURCE CAPSULE (LRHSC) Quarterly Progress Report, 1 Apr. –30 Jun. 1969
15 Aug. 1969 69 p refs
(Contract AT(29-2)-2338)
(AI-AEC-12875; QPR-8) Avail: CFSTI

Progress on the development of a large radioisotope heat source capsule capable of operating in a space environment at a surface temperature of about 2000 F for five years or more is reported. The objectives of the present phase are to design, fabricate, test, and evaluate a test capsule. The following tasks were accomplished: the microstructures of tantalum base alloy components were determined and documented; metallurgical analyses of all abort fire capsule samples and impact capsules were completed; other metallurgical analyses were initiated; the deep drawing of six structural shells and the assembly of a creep capsule and impact capsule were completed; capsule creep testing of T-111 structural shells and impact and fire testing of sample capsules continued. NSA

N70-22826# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
THERMODYNAMIC DATA PROGRAM INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES Quarterly Report, 1 Feb. –1 May 1969
E. A. Aitken and S. K. Evans Aug. 1969 11 p refs
(Contract AT(04-3)-189)
(GEAP-12027; QR-7) Avail: CFSTI

The continuing work related to measurement of liquidus-solidus transformations, vaporization of uranic and oxygen redistribution in a temperature gradient is presented. A possible mechanism for the appearance of a plutonium-to-uranium gradient in the high temperature regions of the fuel is presented and analyzed from existing thermodynamic data. The mechanism is based on preferential vaporization of uranium and plutonium species along a temperature gradient until a steady-state composition is achieved. Author (NSA)

N70-22943# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
FAST FLUX TEST FACILITY Quarterly Technical Report, Jun. –Aug. 1969
E. R. Astley Oct. 1969 170 p refs
(Contract AT(45-1)-1830)
(BNWL-1174) Avail: CFSTI

Fast flux test reactor operations are reviewed and descriptions are given on progress in the following tasks: plant design, components, instrumentation and control, sodium technology, core design, fuels and materials, fuels recycle, and safety. E.C.

N70-22994# Reactor Centrum Nederland, Petten.
FAST REACTOR PROGRAMME Quarterly Progress Report, 1969
E. K. Hoekstra, comp. Oct. 1969 86 p refs
(Contract EURATOM-TNO/RCN-013-65-1-RAAN)
(RCN-111; QPR-1) Avail: CFSTI

Progress of the fast reactor development work carried out during the first quarter of 1969 is described. The program comprises reactor physics, fuel performance, radiation damage in canning materials, corrosion behavior in canning materials, aerosol research, and heat transfer and hydraulics. Author (ESRO)

N70-22996 Maryland Univ., College Park.
THE DYNAMIC RESPONSE OF A NONLINEAR REACTOR SYSTEM
Yung Shen Lu (Ph.D. Thesis) 1968 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-8049

Both Weiner's nonlinear theory and functional power series have been studied and the latter has been applied to nuclear reactor kinetics problems. The systems studied include the open loop equations and systems with temperature feedback. The Functional Power Series method proved to be the most useful, since the necessary nonlinear kernels could be determined experimentally or analytically. Expressions for the first, second, and third order kernels were derived for mathematical models of reactor systems, and quantitative estimates of the significance of the nonlinear treatment were made. The results indicated errors as large as 50% in the reactor power at ten seconds after a large step insertion of sigma k = .003, if nonlinearities were not included. The inclusion of the second and third order kernels reduced these errors by a factor of three. Dissert. Abstr.

N70-23100*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STUDY OF BRAYTON CYCLE POWER GENERATION SYSTEM USING SNAP-8 NUCLEAR REACTOR AS AN ENERGY SOURCE
Donald C. Guentert and Roy L. Johnson Washington Apr. 1970 32 p refs
(NASA-TN-D-5751; E-5317) Avail: CFSTI CSCL 18E

Estimates of system characteristics were obtained for a SNAP-8 reactor-powered Brayton system. At 950 K turbine inlet and 978 K reactor outlet temperatures and a 600-kW reactor power, a net unconditioned power output between 97 and 135 kW, including a 10-percent design margin, can be obtained at specific radiator areas between 53 and 71 sq ft/kW electric. Unshielded system specific weight is estimated to be about 150 lb/kW electric. At 894 K turbine inlet and 922 K reactor outlet temperatures, power output is 108 kW electric at a specific radiator area of 77 sq ft/kW electric. Selection of cycle design conditions and working fluid molecular weight is discussed. Author

N70-23193# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PLUTONIUM UTILIZATION PROGRAM TECHNICAL ACTIVITIES Quarterly Report, Jun.–Aug. 1969
Oct. 1969 78 p refs
(Contract AT(45-1)-1830)
(BNWL-1224) Avail: CFSTI

Brief discussions are presented of accomplishments in the areas of: reactor neutronics, fuels technology, and reactor safety. The plutonium recycle test reactor is presently being put in a standby status. E.M.C.

N70-23226*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NEUTRONIC DESIGN OF A REACTOR CORE CONTAINING HEAT PIPES FOR APPLICATION TO A NUCLEAR AIRPLANE
Richard L. Puthoff [1969] 21 p refs
(NASA-TM-X-52765; E-5571) Avail: CFSTI CSCL 18E

A study was conducted to perform the neutronic calculation on the proposed heat pipe reactor design. The study revealed that utilizing heat pipes for a nuclear airplane reactor application appeared promising when heat pipe performance was applied to the limit of heat pipe technology. The design parameters calculated are number of heat pipes, radial heat flux, core diameter, core L/D, heat pipe vapor temperature, fuel enrichment, fuel loading, clad temperature, clad stress, and power. Author

N70-23343# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Applied Mathematics Branch.
FISSION PRODUCT DATA FOR THERMAL REACTORS. PART 1: CROSS SECTIONS
W. H. Walker Dec. 1969 99 p refs
(AECL-3037-Pt-1) Avail: CFSTI; Atomic Energy of Can., Ltd., Chalk River: $2.00

A compilation and evaluation is presented of cross section measurements for all fission products with half lives exceeding approximately 5 h in the mass range 76 to 165. Resonance integrals, 2200 m/s cross sections and reactor spectrum cross sections are included. Resonance integrals computed from resonance parameters are included in the resonance data if available. A set of recommended cross sections and resonance integrals is also given for use in the FISSPROD data library. Author

N70-23372# Oak Ridge National Lab., Tenn.
GAS-COOLED REACTOR PROGRAM Semiannual Progress Report, Period Ending 30 Sep. 1968
Ann W. Savolainen, ed. Mar. 1969 300 p refs
(Contract W-7405-eng-26)
(ORNL-4353) Avail: CFSTI

Information concerning the development of high temperature gas cooled reactors is presented. General topics discussed include: high temperature gas cooled reactor development; gas cooled fast reactor development; and prestressed-concrete reactor pressure vessel research and development. NSA

N70-23499# Illinois Univ., Urbana.
COMPARISON OF UNCOLLIDED PORTION OF GAMMA RADIATION PENETRATING RIBBED AND PLANE SLABS Final Report
Gaston Dubois and Edgar E. Morris Aug. 1969 72 p refs
(Contract DAHC20-70-C-0201)
(AD-698580; NRSS-12) Avail: CFSTI CSCL 18/8

Exposure ratios and average exposure ratios which compare the penetration of uncollided gamma radiation through ribbed and plane concrete slabs of infinite lateral extent are reported. The mass thicknesses of the plane slabs are assumed to be equal to the average mass thicknesses of the ribbed slabs. Formulas are developed for broad, monodirectional, monoenergetic sources and data are tabulated for 1.25-MeV, fan and plane isotropic sources. Parameters are also presented for an empirical formula which approximates the average exposure ratio for fan and plane isotropic sources. Author (TAB)

N70-23773# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
FAST NUCLEAR REACTOR FUELS: PREPARATION, FABRICATION, PHYSICAL AND CHEMICAL PROPERTIES [COMBUSTIBLES POUR REACTEURS A NEUTRONS RAPIDES; PREPARATION, FABRICATION, PROPRIETES PHYSIQUES ET CHIMIQUES]
Jacqueline Tostain Dec. 1969 143 p refs In FRENCH; ENGLISH summary
(CEA-BIB-149) Avail: CFSTI

This bibliography deals with the papers published between

1958 and 1968 on fuels for fast nuclear reactors (preparation, fabrication, physical and chemical properties). The abstracts of the papers are included. Author (ESRO)

N70-23798# Aktiebolaget Atomenergi, Nykoping (Sweden).
EXPERIMENTAL AND THEORETICAL DYNAMIC STUDY OF THE AGESTA NUCLEAR POWER STATION
P.-A. Bliselius, H. Vollmer, and F. Akerhielm Dec. 1969 40 p refs
(AE-376) Avail: CFSTI

Special attention was paid to the final and unpublished experiments performed in 1965-66. These experiments are discussed and compared to the theoretical predictions. Transfer functions and step responses were measured by perturbations in reactivity and steam load. Three methods were used for transfer function measurements: step functions, trapeze waves, and multifrequency functions based on the Pseudo-Radnom Binary Sequence (PRBS). From the frequency analysis it was found that the different perturbation methods led to consistent results. For the Agesta application the PRBS method was demonstrated to be an accurate and practical method for obtaining experimental transfer functions. The step technique did not give satisfactory results for frequencies above approximately 0.01 Hz. The predicted transients compared well with the measured ones. However, there was a tendency to more peaked power transients from the model. Author (ESRO)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N70-22527 National Lending Library for Science and Technology, Boston Spa (England).
MEASUREMENT OF ELECTRICAL CONDUCTIVITY OF OXIDES AT HIGH TEMPERATURES
E. G. Spiridonov et al 21 Nov. 1969 6 p Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur (Moscow), v. 7, no. 4, 1969 p 798-800
(NLL-RISLEY-Trans-1848-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The electrical conductivity of oxides acting as electrodes in MHD generators or as solid electrolytes in fuel cells was measured at high temperatures. Measurements were carried out both with ac at various frequencies and with dc. In the case of ceramic oxides of high ionic conductivity and varying grain size and porosity, the frequency of the ac is of considerable significance. Methods of measuring the electrical conductivity and selecting the optimum temperature range between 1000 and 2000 C were compared. Results show the temperature effects on the resistance of zirconium oxide and yttrium oxide fired at 1650 C as measured by four and two probe methods with power frequency ac and with a dc bridge circuit. The resistance values and the calculated conductivity activation energy values for different temperature regions are given. S.S.

N70-22558# Cambridge Acoustical Associates, Inc., Mass.
RADIATION OF IMPULSIVE ACOUSTIC TRANSIENTS
Miguel C. Junger Nov. 1969 72 p refs
(Contract N00014-69-C-0096)
(AD-698825; CAA-U-330-210) Avail: CFSTI CSCL 20/1

The pressure pulses radiated by boundaries undergoing a velocity step are studied for various plane and convex source geometries. The distribution of the work performed by the boundary between kinetic energy in the incompressible near-field and acoustic energy radiated to the far-field is analyzed. A variety of analytical formulations and asymptotic techniques applicable to acoustic transients are illustrated. Author (TAB)

N70-22568# California Inst. of Tech., Pasadena. Antenna Lab.
GEOMETRICAL OPTICS FOR TEMPORAL AND SPATIAL DISPERSIVE MEDIA Technical Report
Lennart Marin Nov. 1969 32 p refs
(Contract AF-AFOSR-1400-68)
(AD-698812; AFOSR-69-2811TR; TR-51) Avail: CFSTI CSCL 20/14

A method of finding the asymptotic solution of problems of wave propagation in dispersive media is presented. The medium is supposed to be linear, nonhomogeneous, temporal and spatial dispersive. Two large parameters, rho, mu are introduced; the first of them describing the spatial dispersion of the medium. The method is an attempt to find asymptotic solutions of a special kind of integro-differential equations. The expansions lead to a ray method, i.e., functions that occur satisfy ordinary differential equations along special characteristics curves: the rays. Author (TAB)

N70-22668 Stanford Univ., Calif.
CRITICAL OPALESCENT LIGHT SCATTERING IN HELIUM 3
Julian Pierce Webb (Ph.D. Thesis) 1968 164 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-8294

The intensity of light scattered from density fluctuations in the He(3) sample was measured as a function of sample temperature and scattering angle along isobars immediately above the critical isobar. A beam of light incident on an inhomogeneous dielectric medium is scattered by fluctuations in the dielectric constant of the medium. These fluctuations in the bulk dielectric constant are related to fluctuations in the density through the Lorentz-Lorenz equation. In the immediate vicinity of a critical point, thermodynamic fluctuations which are normally microscopic in scale increase to essentially macroscopic proportion. This dramatic growth of density fluctuations, both in amplitude and in the spatial range over which fluctuations are correlated, enhances the scattering of light tremendously, which is the phenomenon of critical opalescence. The growth of isothermal density fluctuations as the critical point is approached, results from a vanishing of the thermodynamic restoring force which promotes density homogeneity. This restoring force is given by the partial derivative of the chemical potential with respect to density at constant temperature. Dissert. Abstr.

N70-22738 Clarkson Coll. of Technology, Potsdam, N.Y.
LIGHT SCATTERING FROM LONG THIN GLASS CYLINDERS AT OBLIQUE INCIDENCE
Derry Douglas Cooke (Ph.D. Thesis) 1969 313 p
Avail: Univ. Microfilms: HC $14.20/Microfilm $4.05 Order No. 69-21160

Angular scattering functions over a range of observation were calculated for infinitely long circular cylinders at oblique incidence with m = 1.46. The equivalence of the cross components i sub 12 = i sub 21 is noted. As the cylinder is tilted, the structure of the angular patterns becomes smoother and resembles the dielectric-needle approximation. The angular distribution of the light scattered by long, thin glass cylinders was measured at both perpendicular and oblique incidence using a newly designed light-scattering photometer; these results were compared with theoretical calculations. Each set of data could be fitted uniquely to a calculated result corresponding to a particular size parameter. The size parameters thus obtained for the same fiber at two wavelengths and several tilt angles agreed with each other. Dissert. Abstr.

N70-22833# Arizona State Univ., Tempe. Engineering Research Center.
TENSION AND DAMPING EFFECTS ON VIBRATING

STRINGS, PART 3
Frederick Donald Norvelle, James W. Turnbow, and O'Neill J. Burchett Oct. 1969 257 p refs
(Grant NSF GK-2641)
(PB-187249) Avail: CFSTI CSCL 20K

The results of the experiment of study of nylon strings are presented with the corresponding computed fret positions for classical and flamenco guitars. The calculated or selected values from calculated curves locating the positions of the frets for any fretted musical instrument. The accuracy of this system of fret placement was verified by the experimental parts of the study. The effects of string heights above the stopping board and the effects of different diameter and lengths of strings were studied and those effects are denoted. Author (USGRDR)

N70-22856*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PHYSICS
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 23-28 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 20I

The effect of cooling on boundary layer stabilization with subsequent temperature reversal is sometimes brought to a re-reversal by further cooling with secondary stabilization. It is assumed that only the first mode is stabilized by cooling and that a second-mode unstable region always exists regardless of the ratio of wall temperature to recovery temperature; in general the second-mode maximum amplification rate increases with cooling. Inviscid neutral solutions of stability equations are used to demonstrate the theoretical temperature reversal effect on the amplitude ratio as caused by disturbances induced at fixed low Reynolds number that traverse before reaching the second mode instability region. Also discussed is a statistical correlation method for identifying magnetosonic waves in Mariner 5 data by comparing density and the magnetic field component parallel to the "frozen in" field. Approximative calculations on the noon-midnight meridian of the three-dimensional magnetosphere show: (1) it is unlikely that the night side auroras occur on the last closed magnetic field lines; and (2) that day side auroras are associated with field lines a degree or further south in latitude than the field line that goes to the neutral point. G.G.

N70-22894 Yale Univ., New Haven, Conn.
QUANTIZATION OF GRAVITATIONAL FIELD FLUCTUATIONS
Robert Henry Gowdy (Ph.D. Thesis) 1968 335 p
Avail: Univ. Microfilms: HC $15.10/Microfilm $4.30 Order No. 69-8357

Quantum general relativity is discussed within the framework of Feynman sum-over-histories quantization. The approach is illustrated by scalar field calculations. A treatment of differential geometry and general relativity in terms of differential forms is provided. The characteristic length is obtained by assuming that particle quantization follows solely from the quantization of geometry. Gerald Rosen's result for field moments is obtained in our formalism and indicates a breakdown of Feynman's sum-over-histories rule for expectation values in general relativity. A perturbation expansion of field moments and the U matrix for general relativity is considered. Rosen's result is again verified in the zero order theory. The zero order U matrix is found to be reasonable for a free tensor field despite the surface terms in the integrated scalar curvature which was used for the action. It is also found that higher order terms cannot be ignored even for calculations involving only very small gravitational field fluctuations. Dissert. Abstr.

N70-22935 Catholic Univ. of America, Washington, D.C.
CREEPING WAVE PULSES ON SOFT CIRCULAR CYLINDERS
John V. Mc Nicholas (Ph.D. Thesis) 1968 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-8900

The formalism of the creeping wave theory, used for a description of sound scattering from a soft cylinder, has been extended to enable calculations of various incident pulse forms. The particle velocity on a circular cylinder surface and the pressure radiated to a far distant observer of the creeping pulses have been calculated for various pulse shapes. The incident pulse shapes studied are: (1) the delta function, (2) finite modulated step pulse, and (3) finite unmodulated step pulse. The growth curves of particle velocity and pressure have been calculated as a function of a reduced time T. In addition, the creeping wave speed and attenuation angle are given for the case of the delta pulse and the finite modulated step pulse. Dissert. Abstr.

N70-22936 California Inst. of Tech., Pasadena.
TYPE D GRAVITATIONAL FIELDS
William Morris Kinnersley (Ph.D. Thesis) 1969 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-5688

The Newman-Penrose tetrad equations are set up for the principal tetrad of a Type D gravitational field in vacuum. With no further assumptions, the equations are integrated, yielding an exhaustive list of Type D vacuum metrics. The solutions all possess two commuting Killing vectors and depend on from one to four arbitrary constants. The Type D fields with expanding rays are six closely related versions of Kerr-NUT space, the Ehlers-Kundit C metric, and a new generalization of the C metric possessing rotation. For zero expansion we find the three Ehlers-Kundt B metrics, plus rotating generalizations of each. The six Kerr-NUT metrics are interpreted as spinning particles with timelike, lightlike, or spacelike momentum and angular momentum vectors occurring in all possible combinations. The C metric is tentatively identified as a gravitational analog of the runaway solutions encountered in electrodynamics, i.e., a point mass executing hyperbolic motion. Dissert. Abstr.

N70-22952# Saclant ASW Research Center, La Spezia (Italy).
SOUND ATTENUATION BETWEEN 200 Hz and 10 kHz
Audun Skretting and Claude Leroy 1 Oct. 1969 42 p refs
(Saclantcen-TR-156) Avail: CFSTI

Trials were conducted in the Western Mediterranean to confirm the excess attenuation of sound at frequencies between 200 Hz and 10 kHz. As sound propagation along the deep refracted path in the isothermal deep water of the Mediterranean is only affected by geometrical spreading and attenuation, it is possible to measure the attenuation separately for each frequency. The trials used explosive sound sources at different depths and at accurately determined ranges between 200 m and 30 km. Author

N70-22999*# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.
RESEARCH INTO ADVANCED CONCEPTS OF MICROWAVE POWER AMPLIFICATION AND GENERATION UTILIZING LINEAR BEAM DEVICES Semiannual Status Report, Period Ending Dec. 1969
P. R. Mc Isaac Dec. 1969 22 p refs
(Grant NGL-33-010-047)
(NASA-CR-109283) Avail: CFSTI CSCL 20N

A theoretical study on some aspects of the interaction between a drifting stream of electrons with transverse cyclotron motions and an electromagnetic field is summarized. Particular emphasis is given to the possible generation and amplification of millimeter waves. A discussion is included of the results of a digital computer study of the start oscillation conditions for a spiraling filamentary electron beam in a cavity and some of the conclusions that can be drawn from this study. Author

N70-23014# Siemens A. G., Munich (West Germany).
STATE OF DEVELOPMENT FOR CONSTRUCTION OF LARGE SUPERCONDUCTING MAGNETS [STAND DER ENTWICKLUNG BEIM BAU GROSSER

SUPRALEITUNGSMAGNETE]
Guenther Bogner Repr. from Elektrotech. Z. (West Berlin), Ausgabe A, v. 89, No. 14, Jul. 1968 p 321-325 refs In GERMAN
Avail: CFSTI

A complete stabilization technology makes it possible to build completely safe and economic superconducting magnets of desired dimensions. Already manufactured are magnets with field energies of 1 to 10 MW; others with energies of up to 100 MW are almost completed and magnets with about 1000 MW are already projected. Current densities of such magnets reach high field energies of 20 to 80 kOe in the region of 1 to 10 kA/sq cm. Specific dipole of quadrupole magnets require high current densities of about 50 kA/sq cm which seem to be practical at partial stabilization. Transl. by G.G.

N70-23095 Syracuse Univ., N.Y.
CONSERVED QUANTITIES IN ASYMPTOTICALLY FLAT SPACE-TIME
David Clyde Robinson (Ph.D. Thesis) 1968 95 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-8649

The Newman-Penrose (N.P.) constants in flat and asymptotically flat space-times are considered. In Minkowski space-time the Kirchoff integrals for the zero mass free fields of arbitrary spin are calculated with the use of Green's theorem. These integrals express the fields in terms of initial data given on null surfaces and in the asymptotic limit become identical with the first set of N.P. constants when properly weighted. The higher order N.P. constants are associated with derivatives of these expressions. For fields derivable from a variational principle the Noether equations are constructed and used to identify the invariant transformations generated by the constants. The invariant changes in the fields are expressed in terms of the generalized Hertz potentials and have support confined to the null cone at infinity. The constraints in asymptotically flat space-time are calculated by constructing the conformal compactifications of these spaces and using Green's theorem. Dissert. Abstr.

N70-23441# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
WAVE PROPAGATION IN AN INHOMOGENEOUS MEDIUM
Hal Watson, Jr. 1 Dec. 1969 25 p refs
(Contract N00014-68-A-0515; Proj. Themis)
(AD-698296; THEMIS-SMU-TR-50) Avail: CFSTI CSCL 20/1

The effects of a high concentration of particulate matter held in suspension in water on the propagation of an acoustic wave in water is discussed. Expressions for the average wave speed, average pressure, and incoherence of the pressure field are obtained for an incident harmonic pressure wave on a large number of discrete, suspended scatterers in water. The wavelength of the wave is assumed to be large compared to a scatterer diameter. Results are compared with experiments of acoustic wave propagation in sand-water mixtures. Author (TAB)

N70-23488# Naval Research Lab., Orlando, Fla. Underwater Sound Reference Div.
ACOUSTIC CHARACTERISTICS OF A GLASS FILAMENT WOUND PRESSURE VESSEL Final Report
A. Mark Young and Joseph F. Prandoni 28 Nov. 1969 19 p refs
(AD-698282; NRL-7013) Avail: CFSTI CSCL 14/2

Acoustic insertion loss of a glass-filamont-wound pressure vessel intended for transducer calibration varies significantly as a function of frequency, position, and hydrostatic pressure. The variations are believed to be due to voids in the glass-resin and in the glass-resin/rubber liner interface, which give rise to large changes in the characteristic impedance of the composite walls as a function of the same variables. Author (TAB)

N70-23677 National Lending Library for Science and Technology, Boston Spa (England).
ON MEASUREMENTS OF THE LIGHT INTENSITY FACTOR ON PROBES OF ANY REFLECTIVITY
Heinrich Korte et al 21 Nov. 1969 13 p ref Transl. into ENGLISH from Lichttechnik (Vienna), no. 19, 1967 p 135A
(NLL-MT-Trans-6504-(5809.95)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A method using Ulbricht's sphere is described for determining the light intensity factor and the reflection coefficient. Flat probes of magnesium oxide, barium sulfate, and milky glass plates with matt and shiny surfaces were studied. Spectral values were also found by placing a series of double-line interferometers in succession in the light path. It is concluded that Ulbricht's sphere yields more accurate results than is generally considered, and that barium sulfate has excellent properties. N.E.N.

N70-23866# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
SOUND GENERATION BY A TURBULENT AIR JET OVER A FINITE FLATPLATE [ZUR SCHALLERZEUGUNG DURCH EINEN TURBULENTEN LUFTSTRAHL UEBER EINER ENDLICH GROSSEN EBENEN PLATTE]
F.-R. Grosche 1969 130 p refs In GERMAN Prepared jointly with Max-Planck-Inst. fuer Stroemungsforsch. *Its* Mitt. no. 45
Avail: CFSTI

The generation of sound by an air jet of high subsonic speed, issuing from a slot nozzle and striking a flat, rigid plate of finite magnitude was 'shield' investigated on a test stand as these configurations are of interest in shielding the noise from jet engines. The dependence of the remote acoustic radiation field of the shield on the jet velocity and the distance between the jet axis and the shield as well as the sound source distribution in the turbulent jet with and without the shield were studied. In the case of small disturbances between the shield and jet axis an additional sound was generated near the rear side of the shield, due to acoustic dipoles produced by turbulent pressure variations on the shield surface. The quadrupole radiation of the free turbulence was diminished by the shield. ESRO

N70-23867# Max-Planck-Institut fur Stromungsforschung, Gottingen (West Germany).
ACOUSTIC RADIATION OF TWO PAIRS OF COUNTERFLOWING POTENTIAL VORTICES [ZUR SCHALLABSTRAHLUNG ZWEIER AUFEINANDER ZULAUFENDER POTENTIALWIRBELPARRE]
Sayeed-ur-Rahman 1969 49 p refs In GERMAN
(Rept-2-69) Avail: CFSTI

The sound generated by the frontal collision of two vortex pairs is described by means of the Laplace equation for the internal domain, and the wave equation for the external one. The wave equation is solved by means of matched asymptotic expansions. The total sound energy radiated follows a V to the 8th power law (V = velocity), while the acoustic potential and the pressure follow a M squared law (M = Mach number). Sound propagation is primarily in the incoming and outgoing direction of the vortices. ESRO

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N70-22523# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
INVESTIGATION OF THE PROPERTIES OF THE

NEUTRON-DEFICIENT CESIUM NUCLEI. PART 2: THE ISOMER Cs 122m SUB 1 (HALF-LIFE = 0.35 sec)
W. Neubert, Ch. Droste, T. Morek, S. Chojnacki, K. Alexander et al 1969 13 p refs In RUSSIAN
(JINR-P6-4591) Avail: CFSTI

The previously reported isomeric state in Cs-122 produced via the reactions In-113(C12,3n)Cs-122 and Ag-109(O-18,5n)Cs-122 was reinvestigated. The isomeric level decays with a half-life of T sub 1/2 = 0.35 + or - 0.07 sec. From conversion electron measurements it follows that the 81.5-keV transition has the multipolarity E2 or M2 + 10% E3. Furthermore, a strong electron line corresponding to a 47-keV transition was found. The multipolarity of this transition is probably E3 or M2 + E3. Author (NSA)

N70-22529# National Research Council of Canada, Ottawa (Ontario).
DETERMINATION OF THE ACTIVITY OF RADIOACTIVE NUCLIDES IN GASEOUS PHASE. PART 1: INVESTIGATION OF THE SOURCES OF ERROR IN THE MEASUREMENT OF RADIOACTIVE NUCLIDES PRESENT IN GASEOUS FORM IN PROPORTIONAL COUNTERS [BESTIMMUNG DER AKTIVITAET RADIOACTIVER NUKLIDE IN DERGASPHASE. 1: UNTERSUCHUNG DER FEHLERQUELLEN BEI DER MESSUNG GASFOERMIG VORLIEGENDER RADIOAKTIVER NUKLIDE IN PROPORTIONALZAEHLROHREN]
D. Modes et al 1969 15 p refs Transl. into ENGLISH from Nukleonik (Heidelberg), v. 8, no. 1, 1966 p 15-21
(NRC-TT-1385) Avail: CFSTI

With the aid of a special wall-less counter, an analytical function is constructed which describes the gas discharge mechanism in the restricted proportional region and relates each pulse amplitude to a specific particle energy. On the basis of this condition we investigate the corrections applicable to the absolute determination in cylindrical gas counters of the activity of radioactive nuclides which are present in gaseous form. Author

N70-22539# Virginia Univ., Charlottesville. Div. of Nuclear Engineering.
LUTE AND LATEX, SPECIAL-PURPOSE CODES TO TRANSLATE FROM MODIFIED UK TO ENDF/B FORMAT Technical Report
Donald J. Dudziak and Jason M. Cook Aug. 1969 79 p refs
(Contract DASA01-69-C-0029)
(AD-698832; NE-3383-102-69L) Avail: CFSTI CSCL 18/11

Two special-purpose FORTRAN IV codes have been written to translate neutron interaction and photon production data from an extended version of the UK Data File format to Evaluated Nuclear Data File/B Data File format. The codes operate only on the subset of the general UK neutron data format which was used for the Defense Atomic Support Agency (DASA) sponsored evaluations of sodium, magnesium, silicon, chlorine, potassium and calcium. Descriptions of the codes functions and operation are given, along with input instructions, output descriptions, and indexed listings of all main programs and subroutines. Author (TAB)

N70-22540# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
POLARIZATION OF RADIATION RESULTING FROM PROTON-HELIUM ATOM COLLISIONS. PART 1: RESEARCH. PART 2: ELECTRON SPECTROMETER Final Report
Edward A. Soltysik and Robert L. Gray 10 Nov. 1969 8 p refs
(Contract AF-AFOSR-218-66)
(AD-698836; AFOSR-69-2857TR) Avail: CFSTI CSCL 7/4

The relative cross-sections and the polarization of the light resulting from the excitation of helium by a proton beam has been measured for four transitions. The analysis indicates that there is a small violation of the delta S = 0 spin rule for the excitation of the 3 triplet D and 3 triplet S states of helium by protons. Also measured was the relative cross-section and the polarization of the Balmer light resulting from the capture of an electron by an energetic proton in a collision with a helium atom. In the final study, the relative differential cross-sections for n singlet P transitions in helium with a 50-300 eV electron beam that has a useable energy resolution of 0.175 eV was measured. Author (TAB)

N70-22638 Indiana Univ., Bloomington.
THE BETA SPECTRUM INVESTIGATIONS IN DECAYS OF Cs 134, Sb 122 AND P 32
Moo Ung Kim (Ph.D. Thesis) 1968 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-7104

The beta-spectrum measurements of Cs-134, Sb-122 and P-32 were performed with a high resolution, 40 cm radius-of-curvature, 180 degree focusing, shaped magnetic field spectrometer, employing the energy signature technique which discriminates against the background events and the scattered electrons. A lithium-drifted silicon detector with a depletion depth of 5 mm and a thin entrance window was used as the detector. The discrimination against counts arising from background and instrumental scattering is accomplished by pulse height analyzing the signals from the semiconductor detector and accepting only those which have the proper energy signature corresponding to the momentum setting of the magnetic spectrometer. Dissert. Abstr.

N70-22651# California Univ., Berkeley. Lawrence Radiation Lab.
BEVATRON OPERATION AND DEVELOPMENT, APRIL-JUNE 1969
Kenneth C. Crebbin 27 Aug. 1969 10 p refs
(Contract W-7405-eng-48)
(UCRL-19299) Avail: CFSTI

The Bevatron provided beam for 86.8% of the scheduled operating time. During this period, 2.8 x 10 to the 18th power protons were accelerated. A maximum beam intensity of 5.2 x 10 to the 12th power protons per pulse was achieved. Three primary experiments were completed and three new primary experiments were set up. The piston rod of a hydraulic cylinder used in plunging the extraction magnets for the EPB system failed. Also vertical beam blowup that occurs on flattop when the rf voltage is turned off was correlated to a space charge phenomenon. Author (NSA)

N70-22657 California Univ., Los Angeles.
UNIVERSALITY OF THE WEAK VECTOR COUPLING CONSTANT
Duane Alfred Dicus (Ph.D. Thesis) 1968 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-7240

In the V-A theory of weak interactions with coupling constant G, whether or not it is mediated by an intermediate vector meson, it is shown to order alpha G that the contribution of the vector hadron current to the Fermi part of the amplitude for beta-decay involving hadrons in the same isomultiplet is independent of the details of the strong interactions. This contribution to the radiative corrections to beta-decay has been reevaluated with results that agree in form with those obtained previously with the use of zero order perturbation theory in the strong interactions. The terms of order GZ alpha q<r> do depend on the strong interactions and are evaluated using a model. The results of both orders are applied to some nuclear decays and it is shown that G is universal to within the experimental error. Dissert. Abstr.

N70-22659 Duke Univ., Durham, N.C.
EXACT ABSORPTIVE CORRECTIONS AND THE COMBINED EXCHANGE-CHANNELS MODEL
Arnold Buist Lopez-Cepero (Ph.D.Thesis) 1968 126 p refs
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-3841

This development has, primarily, two features: (1) Calculation of the absorptive form factors directly from the rotation coefficients; and (2) Consideration of the effect of the t- and u-channel contributions, separately and combined, over the full range of momentum transfer. The direct consequences of this approach are as follows: (1) Form factors more directly associated with the relative helicities of initial and final state; (2) An easy, direct calculable expression for the total reaction cross section and (3) Inclusion of baryon exchange. For the reaction, over the range of energies considered, the t- and u-channel exchange mechanisms appear to be distinctly limited to rho-meson exchange and proton exchange. The overall effect of combining the two exchange channels is a much improved fit to the data, with quite excellent reproduction of the angular distributions and a varying range of agreement for the spin-space density matrix terms. Dissert. Abstr.

N70-22677 Tulane Univ., New Orleans, La.
EFFECTS OF NEIGHBORING ATOMS IN MOLECULAR ORBITAL THEORY
Joyce Hooper Corrington (Ph.D.Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-3786

In molecular orbital theory, in order to solve the secular equation for the molecular orbital energies, it is necessary to estimate the elements of the energy or Hamiltonian matrix, and of the atomic wave function overlap matrix. There is no satisfactory means of estimating the diagonal elements of the Hamiltonian matrix so that they reflect the molecular environment. Similarly, there is no commonly accepted means of representing the atomic wave functions in a simplified manner so that the overlap elements can be calculated in a molecular environment. In order to adjust the diagonal elements of the Hamiltonian matrix for molecular environment, a neighbor atom potential function is developed from theoretical considerations. A number of molecular examples are calculated and discussed. It is found that the proposed functions improve the accuracy of calculated molecular orbital energies. Dissert. Abstr.

N70-22681 Yale Univ., New Haven, Conn.
EXPERIMENTAL LIMITS FOR THE ELECTRON-PROTON CHARGE DIFFERENCE AND FOR THE CHARGE ON THE NEUTRON
Lawrence Jackson Fraser (Ph.D. Thesis) 1968 179 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-8349

The upper limits to the electric charges on the cesium and potassium atoms have been measured by the method of studying the deflection of an atomic beam in a homogeneous electric field. These upper limits, which are about two orders of magnitude lower than previous measurements on individual atoms, are considered to be consistent with the usual view that atoms are electrically neutral and to be determined primarily by small systematic errors caused by insulating films formed on the electric field plates from trace hydrocarbon contamination. The relevance of these measurements of atomic neutrality to the theory of elementary particles, to astrophysics and cosmology, and to the theory of relativity is discussed. Dissert. Abstr.

N70-22683# Oak Ridge National Lab., Tenn.
SPECTROSCOPY OF F-P SHELL NUCLEI BY (D,N) REACTIONS
Richard Gerald Couch (Ph.D. Thesis—Northwestern Univ.) Nov. 1969 105 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2729) Avail: CFSTI

In order to obtain information on the proton levels in the lf–2p shell, (d,n) reactions on Fe-54,-56, Co-59, and Zn-64,-66,-68 at 10 MeV were studied. Neutron time-of-flight spectra and angular distributions were taken with liquid scintillators. The data were analyzed with the DWBA. NSA

N70-22684# Brookhaven National Lab., Upton, N.Y.
EMITTANCE MEASUREMENTS IN THE AGS SLOW EXTERNAL BEAM
L. N. Blumberg, M. Q. Barton, J. D. Fox, J. W. Glenn, and L. E. Repeta 27 Oct. 1969 26 p refs
(BNL-14202) Avail: CFSTI

The emittance of the AGS slow external beam at p = 29.4 GeV/c was calculated from measurements of nearly instantaneous beam profiles as a function of strength of an upstream quadrupole lens. The vertical emittance resulting from a least squares fit to the data is approximately twice the predicted adiabatic value. The quality of the fits for these and other data presented do not, however, establish the validity of the elliptical contour assumption used in the data analysis. Average width data for the entire SEB spill duration result in an effective vertical emittance. The horizontal SEB data give an emittance of about four times the value predicted by theoretical estimates. The time-averaged horizontal emittance was measured. The horizontal emittance of the AGS fast external beam was measured and is in good agreement with the expected adiabatic value. Data obtained for simultaneous internal and SEB targeting are also reported. Author (NSA)

N70-22686 Indiana Univ., Bloomington.
A STUDY OF SIX-PRONG EVENTS PRODUCED IN NEGATIVE PION PROTON INTERACTIONS AT 6 GeV/c
King Foo Suen (Ph.D. Thesis) 1968 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-7120

Approximately 98,000 pictures were taken with the MURA 30 inch hydrogen bubble chamber. The six prong events selected for investigations were required to have at least 7 inches of track for every track diverging from the production vertex to ensure good momentum determination. Event selection was based on the ionization remark given by the scanner, missing energy and missing momentum. The cross section for different channels were also calculated and compared with the data from other experiments at different energies. They were consistent. A simple statistical model predicts the branching ratios of the same number of particles in different charge states in good agreement with experimental data. However some energy dependence should be inserted into the model. The center of mass angular distribution of each particle in channel 1 and channel 2 were histogrammed. Dissert. Abstr.

N70-22692# Chicago Univ., Ill. Enrico Fermi Inst.
VECTOR-MESON DOMINANCE: PRESENT STATUS AND FUTURE PROSPECTS
J. Sakurai Oct. 1969 36 p refs Presented at the Intern. Symp. on Electron and Photon Interactions at High Energies, Liverpool, 1969
(Contract AT(11-1)-264)
(COO-264-524; EFI-69-91) Avail: CFSTI

The review of vector meson dominance covers the current-field identity, comparison of rho meson(0) yields positive electron + negative electron and rho meson(0) yields pion (+) + pion(-), the rho meson-photon analogy, single-pion photoproduction and frame dependence, vector meson photoproduction and total photoabsorption cross sections, a table for the meson (rho meson) coupling constant, broken SU(3) and omega meson–phi meson mixing, and the classical versus the frontier region, also other vector mesons, asymptotic behavior of the colliding beam cross section, the nucleon form factor, inelastic electron–proton scattering; and future experiments are discussed. NSA

N70-22717# Bradley Univ., Peoria, Ill. Physics Dept.
AN INSTRUCTIVE EXAMPLE OF THE SUDDEN APPROXIMATION IN QUANTUM MECHANICS
D. W. Schlitt and C. Stutz [1969] 18 p refs
(Grant NSF GP-7389)
Avail: CFSTI

Some features of the sudden approximation are examined and applied to the example of a particle in a suddenly expanded box. Among the points illustrated are the form of the work energy relation in quantum mechanics, the application of the energy-time uncertainty relation, some pitfalls in the use of theorems which apply only to hermitian operators, and the periodic time dependence of expectation values. Author

N70-22770# Princeton Univ., N.J.
A SEARCH OF HEAVY MUON BY WIDE ANGLE MU BREMSSTRAHLUNG AT NAL
K. W. Chen [1969] 22 p refs
(Contract AT(30-1)-2137)
(PURC-2137-15) Avail: CFSTI

It is shown that a test of QED in the muon propagator can be performed at NAL with a sensitivity substantially higher than the g-2 experiment. Utilizing a highly collimated beam of high intensity and low divergence, heavy muon mass up to 8 GeV/sq c can be searched for. The contribution to wide angle bremsstrahlung from nuclear Compton scattering and inelastic bremsstrahlung need to be carefully investigated but are expected to contribute insignificantly if sufficient care is taken to choose the proper kinematical configuration of the outgoing muon and the gamma ray. Author (NSA)

N70-22772# Oak Ridge National Lab., Tenn.
TABULATED CROSS SECTIONS FOR HYDROGEN AND HELIUM PARTICLES PRODUCED BY 62-MeV PROTONS ON Y 89
F. E. Bertrand and R. W. Peelle Oct. 1969 35 p refs
(Contract W-7405-eng-26)
(ORNL-4450) Avail: CFSTI

Tabulated differential cross sections are presented for the production spectra of protons, deuterons, tritons, helium-3, and alpha particles from Y-89 bombardment by 61.5-MeV protons. Five detector angles were employed in the range 30 to 124 deg. The continuum cross sections are given from the maximum energy down to a cutoff (2 to 7 MeV) which depends on particle type. Some improvements in the analysis procedure are discussed. Author (NSA)

N70-22773# Hawaii Univ., Honolulu. Dept. of Physics and Astronomy.
HIGH ENERGY PHYSICS GROUP Annual Progress Report
15 Oct. 1969 79 p refs
(Contract AT(04-3)-511)
(UH-511-60-69) Avail: CFSTI

The report of the high-energy physics group at the University of Hawaii covers research for the year 1969. This research is both experimental and theoretical and includes bubble and spark chamber experiments. Publications and reports issued during this period are also listed. NSA

N70-22801# California Inst. of Tech., Pasadena.
SINGLE PION PHOTOPRODUCTION IN THE RESONANCE REGION
Robert L. Walker Sep. 1969 47 p refs Presented at the Intern. Symp. on Electron and Photon Interactions at High Energies, Daresbury, England
(Contract AT(11-1)-68)
(CALT-68-219; CONF-690911-3) Avail: CFSTI

A brief review of pion photoproduction in the resonance region, a discussion of a simple quark model of baryons, previously given, for the main features of the interaction studied, and a survey of related recent experimental data are presented. NSA

N70-22834 California Univ., Berkeley.
PION(+) p 4-PRONG INTERACTIONS BETWEEN 3 AND 4 GeV/c
David Gordon Brown (Ph.D. Thesis) 1968 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-3572

The Lawrence Radiation Laboratory 72-inch hydrogen bubble chamber was exposed to a beam of positive pions at incident momenta ranging from 2.95 to 4.08 GeV/c. The resulting film yielded 39,000 4-prong interactions which were processed using the FSD device and the Fog-Cloudy-Fair data reduction system. Formation of N* (2850) and production of the dominant quasi-two-body final states were investigated. In particular the double resonance channels N*(++)neutral rho meson, N*(++)neutral f meson, N*(++)neutral omega meson, and N*(++)neutral eta meson were sufficiently free from background to allow consideration of their production mechanisms as seen in their cross-sections and angular distributions. One-meson-exchange models were found to account correctly for the general features of the first reaction although being inadequate to explain the fine structure of the experimental distributions. Dissert. Abstr.

N70-22835# Columbia Univ., New York.
THREE-BODY CALCULATIONS WITH LOCAL POTENTIALS
D. D. Brayshaw Jul. 1969 9 p refs Presented at the Intern. Conf. on the Three-Body Probl., Birmingham, England
(NYO-1932(2)-151; CONF-690710-2) Avail: CFSTI

A two-term separable approximation to the two-particle t-matrix is developed which preserves exact behavior at each bound state or resonance pole. While introducing no additional singularities, the approximation also produces the exact right-hand cut. This separable approximation is applied to the three-particle scattering problem with local potentials, and numerical results are obtained for the three-body binding energy in the case of the Yukawa and exponential potentials. These results are shown to be in good agreement with those recently published by Humberston, Hall and Osborn. Author (NSA)

N70-22845# National Physical Lab., Teddington (England). Div. of Quantum Metrology.
AN OMEGATRON MEASUREMENT OF THE MAGNETIC MOMENT OF THE PROTON IN TERMS OF THE NUCLEAR MAGNETON
B. W. Petley and K. Morris Nov. 1969 30 p refs
(NPL-QU-7) Avail: CFSTI

The magnetic moment of the proton in terms of the nuclear magneton has been measured as the ratio of the proton spin precession and cyclotron frequencies. The cyclotron frequency was measured by the omegatron method using H2(+), HD(+) and d2(+) ions at 0.47 T (4.7 kG) and the skewness of the resonance investigated. The results for p/N with standard deviations are 2.792 746 + or − 0.000 053 and 2.792 820 + or − 0.000 053 (19 ppm) without and with the correction for the diamagnetism of water, respectively. Author (ESRO)

N70-22873 Syracuse Univ., N.Y.
STUDY OF Y*(1660) AND Y*(1700) IN KAON(-) PROTON INTERACTIONS AT 4.6 BeV/c and 5.0 BeV/c
Milton Chester Primer (Ph.D. Thesis) 1968 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-8645

Approximately 300,000 pictures were taken in several exposures of 80 inch liquid hydrogen bubble chamber to a separated kaon(-) beam. Significant Y*(1660)(+) production was observed at these energies primarily in the sigma hyperon (0) pion(+) and (sigma pion pion)(+) states from a study of the reaction channels. A detailed analysis of these channels is given. Previous determinations of the branching fractions of the Y*(1660) are reviewed; a compilation and discussion of these results is presented. Dissert. Abstr.

N70-22882 Yale Univ., New Haven, Conn.
A MEASUREMENT OF THE 2 2 S1/2 TO 2 2 P3/2 ENERGY SEPARATION IN ATOMIC HYDROGEN

Stanley Lee Kaufman (Ph.D. Thesis) 1968 83 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-8370

A precision measurement of the fine-structure interval in atomic hydrogen is reported. Hydrogen atoms in the 2S state are produced directly bombarding molecular hydrogen with electrons. An RF electric field induces mixing with the 2P states, and the signal results from detection of the ensuing 1216 A radiation. The 2S atoms remain in or near the electron beam in which they are produced. The effects of this environment on the results are estimated, and experimental searches are made for such effects. A method of normalization is described which removes many sources of asymmetry. Small shifts in the results with gas pressure and electron beam current are detected, which may be related to an asymmetry which is shown to exist for unnormalized data. The results of the normalized data are extrapolated to zero pressure and beam current, and fine structure interval is found to be 9911.36 + or − 0.10 MHz. Dissert. Abstr.

N70-22884# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
REPORT ON HIGH ENERGY PHYSICS
Victor F. Weisskopf Jun. 1969 164 p refs Sponsored in part by AEC
(TID-25251) Avail: SOD $1.50

A review is given of the current status of high energy physics research and on the resources and facilities needed to pursue this fundamental field of research with recommendations as to the future program for the coming decade. The topics covered are conclusions, recommendations, and future projections, budgetary implications, recent progress in high energy physics, accelerators, subsidiary equipment for the high energy physics experiments, analysis of data on photographic film, cosmic ray studies in elementary particle physics, university participation in high energy physics research, and international collaboration. Appendices on new accelerator technology, high energy physics manpower survey, and bubble chamber data analysis in the U.S. are included. It is concluded that U.S. high energy physics research can be maintained at a vigorous and productive level with an average cost increase of about 8% per annum over the next decade. NSA

N70-22929# Georgia Inst. of Tech., Atlanta. School of Physics.
SCATTERING OF HE(+) IONS BY NOBLE GASES AT HIGH ENERGIES
G. O. Taylor, Jr., D. W. Martin, and E. W. Thomas 3 Sep. 1969 164 p refs Presented at the 6th Intern. Conf. on the Phys. of Elec. and Atomic Collisions, Cambridge, Mass., 28 Jul.–2 Aug. 1969 Submitted for publication
(Contract AT(40-1)-2591)
(ORO-2591-42) Avail: CFSTI

The scattering of He(+) projectiles by impact on He, Ne, and Ar was investigated in the energy range 120 to 830 keV under single-collision conditions. Specifically, the experiment measured as a function of angle in the range one to eight degrees the total differential scattering cross section as well as the differential scattering cross sections for scattering without change of charge, for scattering with charge transfer, and for scattering with electron stripping. Also, the fraction of particles in a particular charge state was measured as a function of energy at fixed scattering angle. A Van de Graaff accelerator furnished a monoenergetic beam of ions from 120 to 1000 keV. Two circular holes of diameter 0.025 inch collimated the beam entering the collision region, where the target gas pressure was typically one micron. Particles scattered through an angle theta were collimated by a two-slit geometry, whose angular resolution was approximately 10 minutes of arc, passed through a parallel-plate electrostatic deflector for charge sorting, and counted individually with a silicon surface-barrier detector. Dissert. Abstr.

N70-22944# Nebraska Univ., Lincoln. Bealen Lab. of Physics.
ON THE EXISTENCE OF FIXED POLES AND THEIR ROLE IN CONSPIRACY
Paul Finkler [1969] 38 p refs
Avail: CFSTI

It is shown that unitarity allows fixed poles at certain nonsense points of either right or wrong signature. The conditions for the existence of these poles are found. These conditions are then used to locate the poles allowed in hadronic reactions. Possible mechanisms for the poles are considered. It is then argued that fixed poles provide the most natural explanation of the conspiracy phenomenon. Author

N70-22969 Oregon State Univ., Corvallis.
MEASURED LIFETIMES FOR THE FIRST EXCITED J = 1 (3 P1) LEVEL IN ARGON AND KRYPTON
John Ludwig Morack (Ph.D. Thesis) 1969 100 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-4665

This is the first lifetime measurement for a resonance transition in argon and the first direct lifetime measurement for the 4p 5 5s) (3 P1) level in krypton. The experiment in krypton, besides giving an independent deterimination of this lifetime, was used to investigate resonance trapping. These measurements for krypton are the first to be interpreted in terms of the recent theory of resonance trapping developed by D'yakonov and Perel'. The method chosen for these studies is a modified delayed coincidence method. The atomic excitation is produced by bombarding a gas sample with a pulsed beam of electrons. For a given pulse of electrons, the light output from the gas will increase until the excitation is terminated, and then decay exponentially. It is shown that for the exponential decay, the detector output is proportional to the light intensity at the beginning of the sampling interval. The detector output is then amplified and averaged over many decays, allowing the decay curve to be reconstructed by varying the delay time between the turnoff of the excitation and the sampling of the emitted light in discrete steps. Dissert Abstr.

N70-22980 Pennsylvania Univ., Philadelphia.
MODELS FOR RAREFIED-GAS PARTICLES REFLECTED FROM SOLID SURFACES
Terrell Marshall, Jr. (Ph.D. Thesis) 1969 199 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-21402

A data processing scheme is presented which permits the calculation of momentum and energy transfer in an arbitrary gas-surface system under free molecule flow conditions. An adjustable parameter, reflected particle velocity distribution model is developed, model parameters are determined by matching data, and the parameters are correlated with physical properties of the gas-surface system. At present, momentum and energy calculations require the assignment of values to two undetermined parameters in the velocity model with consequent uncertainty in the results. As they become available, momentum and energy exchange data or velocity distribution data can be incorporated to obtain complete and unique results. The velocity model is of modified Maxwell-Nocilla form. It consists of the sum of a generalized specular component, which contains a directed velocity superimposed on a thermal motion having different most-probable speeds in each direction, and a generalized diffuse component. The result is a highly flexible eleven-parameter model. Dissert. Abstr.

N70-22983# Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Lab. di Disimetria e Standardizzazione.
SPECTROMETRY OF X-RAYS EMITTED BY APPARATUSES WITH ACCELERATING VOLTAGE BETWEEN 60-280 kV
E. Casnati, M. Pagnini Fioretti, and S. Piermattei [1969] 33 p refs
(RT/PROT(69)16) Avail: CFSTI

The knowledge of the spectral distribution of a radiation

beam is of fundamental importance in dosimetry problems when it is dealing with the correlation between the energy transfer from radiation to an absorbing medium and the final effect produced on the medium itself. Reported are the results of the spectral distributions of X-rays emitted by two commercial tubes, a Be-window (0.025 cm Be) self-rectifying tube with peak voltage variable in the range 5-80 KV, and a 100-300 KV constant potential apparatur (Trimegagil), inherent filtration equal to 0.05 cm Cu. The methods used are: a) scintillation spectrometry, b) absorption analysis. The scintillation spectrometry by means of a NaI crystal as detector is the most direct method to obtain the spectral distribution of a radiation beam. Author

N70-23019 European Organization for Nuclear Research, Geneva (Switzerland).
NEUTRAL KAON DECAY AND CP VIOLATION
J. Steinberger 9 Jan. 1970 26 p refs
(CERN-70-1) Copyright Avail: Issuing Activity

The neutral kaon system provides an example of degeneration in the strong interaction, and splitting by the weak interaction. This gives rise to some unusual situations, such as the phenomenon of regeneration. It is the only system in which CP violation was observed. While the phenomenological discussion is definitive, the experimental situation is still the subject of active investigation and cannot be considered as settled. Author

N70-23021 Ohio Univ., Athens.
S-MATRIX INPUTS AND RESONANCE PARAMETERS
Sung Chae Chung (Ph.D. Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-5089

Throughout this work, our main concern was elastic collisions with equal mass. The well-known N/D was used to investigate the resonance behavior of the partial-wave amplitude. The whole left hand cut of the amplitude was replaced by two input-poles constrained to satisfy a threshold requirement. The necessary and sufficient conditions for resonance were derived and a narrow resonance is indeed possible. Since the dynamics of crossed channels give rise to the driving force which makes the reaction in the direct channel possible, the mechanism and formalism of the crossed channels is discussed. Using these ideas, we adjusted the position of the input-poles to represent a crossed channel resonance. As one of the most interesting results of this work, we show that it is indeed possible to obtain a narrow resonance, but only by making the position parameters of the input-poles large. We also show that a simple bootstrap mechanics fails to provide a self-generating rho-meson. Dissert. Abstr.

N70-23071 IIT Research Inst., Chicago, Ill.
TWO-CENTER EXPANSION SELF-CONSISTENT-FIELD WAVEFUNCTIONS OF FHF(-) AND ITS COMPUTED PROPERTIES
Tao-kuang Ming (Ph.D. Thesis) 1969 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-21936

The one-center expansion (1CE) approximation was studied thoroughly. The results indicate that energy value of 1CE is good but the wavefunctions are somewhat distorted. The two-center expansion (2CE) approximation was not explored because the method itself has only become available recently. We would expect that 2CD approximation on the system FHF- gives not only a good energy value for that system but also the wavefunction itself. Aside from the molecular quadrupole moment, the molecular properties computed agree with each other quite well. The rather large difference in molecular quadrupole moment can be explained by the small difference of charge distribution in 2CE and 3CE. The symmetrical and unsymmetrical potential curves have also been studied. Dissert. Abstr.

N70-23153 National Lending Library for Science and Technology, Boston Spa (England).
BREAKUP OF MAGNETIC SURFACES IN THE S-1 STELLARATOR
F. V. Karmanov et al. 22 Oct. 1969 5 p refs Transl. into ENGLISH from Kurchatov report IAE-1260, 1966 p 1-7
(NLL-CTO-626-(9091.9F; IAE-1260) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

While investigating the magnetic field in the S-1 stellarator a considerable deformation of the magnetic surfaces was observed. The deformations take the form of projections reaching out from the separatrix toward the chamber wall. They increase with an increasing h sub 3/H sub 0 ratio. Author

N70-23283 Yale Univ., New Haven, Conn.
PRECISION MEASUREMENT OF THE DECAY RATE OF ORTHOPOSITRONIUM
Richard Harry Beers, Jr. (Ph.D. Thesis) 1968 155 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-8314

Positronium, the electron-positron bound state, is an ideal system for tests of quantum electrodynamics and of the Bethe-Salpeter equation. The ground 1S state has two hyperfine levels: parapositronium and orthopositronium. With the assumption of charge conjugation invariance in the electromagnetic interaction, the singlet state can be shown to annihilate only with the emission of an even number of photons (predominately two) and the triplet state only with the emission of an odd number (predominantly three). The annihilation modes of this particle-antiparticle system are fundamental radiation processes, whose characteristic decay rates can be calculated to a high degree of accuracy. Two other quantities determined in this experiment are the rates per psi at which orthopositronium is quenched in the two gases: Freon-12 and argon. Dissert. Abstr.

N70-23357# Georgia Inst. of Tech., Atlanta. School of Physics.
IONIZATION AND CHARGED TRANSFER CROSS SECTIONS Progress Report, 1 Dec. 1968 - 30 Nov. 1969
D. W. Martin, G. O. Taylor, and D. E. Troyer 30 Nov. 1969 11 p refs
(Contract AT(40-1)-2591)
(ORO-2591-43) Avail: CFSTI

A differential scattering apparatus designed for detailed cross section measurements of fundamental ionization and charge transfer processes involving incident hydrogen and helium ions in the energy range from 0.15 to 1 MeV is described. Noncoincidence measurements of the scattering of He(+) ions by Ar, Ne, and He are discussed briefly. Progress on construction of a slow recoil-ion analyzer is reported. NSA

N70-23632# Aktiebolaget Atomenergy, Nykoping (Sweden).
E2 AND M1 TRANSITION PROBABILITIES IN ODD MASS MERCURY NUCLEI
V. Berg (Stockholm Univ.), A. Baecklin (Uppsala Univ.), B. Fogelberg (Uppsala Univ.) and S. G. Malmskog Oct. 1969 28 p refs Submitted for publication
(AE-372) Avail: CFSTI

The L- and M-subshell ratios were measured for the 39.5 keV transition in Hg-193 and the 37.1 and 16.2 keV transitions in Hg-195 yielding 0.38 + or - 0.12, <0.02 and 0.08 + or - 0.03 per cent E2, respectively. The half-lives of the 39.5 keV level in Hg-193 and the 53.3 and 37.1 keV levels in Hg-195 were measured by the delayed coincidence method, yielding values of 0.63 + or - 0.03, 0.72 0.03 and < 0.05 nsec respectively. A systematic compilation of reduced E2 and M1 transition probabilities in odd mass Pt, Hg, and Pb nuclei is given and compared to theoretical predictions. Author (ESRO)

N70-23634# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
SPECTRAL SHAPES AND ANALYSIS OF SOME ONCE-FORBIDDEN BETA TRANSITIONS [FORMES DES SPECTRES ET ANALYSE DE QUELQUES TRANSITIONS BETA UNE FOIS INTERDITES]
Pierre Liaud (Ph.D. Thesis—Grenoble Univ., 15 Jul. 1969) Jan. 1970 111 p refs In FRENCH; ENGLISH summary
(CEA-R-3923) Avail: CFSTI

The shape of the spectra of the once-forbidden beta transitions 1(-) yields 2(+) beta-gamma coincidence system with a time-amplitude converter. A subtraction method has made it possible to obtain the shape of the spectra for the 1(-) yields 0(+) transitions leading to the fundamental levels of Yb-170, Os-186, and Os-188. The nuclear matrix elements for these transitions were also determined, and a comparison was made with the nuclear and theoretical evaluations and was found to be in complete disagreement with that obtained from conserved vector-current theory. The deviation with respect to the unique spectrum shape of the 0(-) yields 2(+) transition was interpreted using Buhring's theory which gives the changes in the lepton radial wave functions on the volume of the nucleus. Author (ESRO)

N70-23639# Massachusetts Inst. of Tech., Cambridge.
THE SIXTH INTERNATIONAL CONFERENCE ON THE PHYSICS OF ELECTRONIC AND ATOMIC COLLISIONS Final Report
I. Amdur 10 Dec. 1969 14 p Conf. held at Cambridge, Mass., 28 Jul.–2 Aug. 1969
(Grant AF-AFOSR-1673-69)
(AD-698778; AFOSR-69-3034TR) Avail: CFSTI CSCL 7/4

An outline of the personnel and subjects are presented for the Sixth International Conference on the Physics of Electronic and Atomic Collisions held at the Massachusetts Institute of Technology during July 28-August 2, 1969. There were 765 registrants from 17 different countries. TAB

N70-23650# Bologna Univ. (Italy). Inst. of Physics.
CONJECTURES ON A CLASS OF PHYSICAL STATES OF FERMI SYSTEMS. THE THERMODYNAMIC LIMIT OF THE BCS STATE
G. Fano and G. Loupias (Montpellier Univ.) [1969] 42 p refs
Avail: CFSTI

A limiting procedure is preopposed for obtaining a new class of physical states for an infinite non-relativistic Fermi system. The thermodynamic limit of vector states in the Fock representation of the C.A.R. algebra, representing a condensed state of atoms each of which is composed of *m* fermions is considered. In the particular case m = 2, this procedure gives the B.C.S. state; in this case the condensation of Cooper pairs is studied rigorously by means of methods adapted from classical statistical mechanics. A simple model in the case m = 4 is considered. This model provides an example of a non quasi-free state with a finite number of non-vanishing truncated functions. Author

N70-23658# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physikinstitut des Reaktorzentrums.
MEASUREMENT OF THE FORWARD-BACKWARD-ASYMMETRY OF Hg 203 [MESSUNG DER VOR-WAERTS-RUECKWAERTS-ASYMMETRIE AN HG 203]
Helmut Woda (Ph.D. Thesis—Wien Univ.) 1969 76 p In GERMAN ENGLISH summary
(SGAE-PH-89/1969) Avail: CFSTI

A parity impurity of a nuclear state should lead to a small forward-backward-asymmetry of the beta-γ angular correlation. An attempt to measure this asymmetry in Hg-203 is described. Because of the source strength necessary which results in a chance rate equal to the real coincidence rate, a special method was developed for the simultaneous measurement of the chance coincidences. In addition, this method greatly reduces the necessary corrections. Several distortions because of the complexity of the decay Hg-203 (β,γ)Tl-203 were determined and the necessary conditions calculated. The measured asymmetry was of the same order of magnitude as calculated from multiple scattering of Compton quanta in the γ-detector. An additional measurement with a back scattering foil (Au) to reverse the direction of electrons emitted at 0 – 180 deg gave no significatt difference. The initial theoretical estimate was revised according to recent measurements. Author

N70-23753# Nebraska Univ., Lincoln. Dept. of Physics.
UNITARIZATION OF THE VENEZIANO MODEL: SOME COMMENTS AND PROBLEMS
D. W. Schlitt [1969] 11 p refs Presented at the High Energy Phys. Conf., Boulder, Colo., Jul. 1969
(Grant NSF GP-7369)
Avail: Issuing Activity

A method for generating a crossing symmetric and approximately unitary amplitude for pion + eta-meson yields pion + eta meson using the Veneziano model as an input is suggested. This method has a prospect of sustaining a rising trajectory with finite width resonances. The possibility of daughter trajectories is present. It is also possible that there will be ancestor trajectories and negative widths. A background amplitude which can be interpreted as a Pomeranchuk contribution seems to be required. Author

N70-23760# Commissariat a l'Energie Atomique, Limeil (France).
RELATIVISTIC HARTREE FOCK CALCULATIONS WITH EXCHANGE [CALCULS HARTREE FOCK RELATIVISTES AVEC EXCHANGE]
Jean-Paul Desclaux Jan. 1920 30 p refs In FRENCH; ENGLISH summary
(CEA-R-3929) Avail: CFSTI

A relativistic Hartree-Fock calculation of atomic wave functions was carried out with the Hamiltonian consisting of the sum of the Dirac Hamiltonians and the interelectronic Coulomb repulsion terms. The first term of the Breit operator was used as the relativistic interelectronic interaction term, and was treated as a first order perturbation. A numerical program which computes the radial functions, energy eigenvalues, and total energy for any atom is described. Numerical results for the ground states of Be, Ne, Xe, Hg, Rn atoms and the D(2) state of copper are also presented. Author (ESRO)

N70-23800 Paris Univ., Orsay (France). Faculte des Sciences.
PULSED ACCELERATORS [ACCELERATEURS PULSES]
Michel Boivin (Ph.D. Thesis) [1968] 27 p refs In FRENCH
Avail: Issuing Activity

Different methods of obtaining very short duration pulses of ions and electrons are surveyed and the achievements of each type (electrostatic and electric fields) of accelerator are discussed. ESRO

N70-23802 Paris Univ., Orsay (France). Faculte des Sciences.
NUCLEAR PHOTOACTIVATION BY MEANS OF 2 MEV ELECTRON ACCELERATOR [PHOTOACTIVATION NUCLEAIRE A L'AIDE D'UN ACCELERATEUR D'ELECTRONS DE 2 MEV]
Michel Boivin (Ph.D. Thesis) 1968 127 p refs In FRENCH
Avail: Issuing Activity

The first part of this report deals with determination of nuclear photoactivation cross sections and the results with selenium 77, silver 107 and 109, cadmium 111, indium 115 and mercury 199 are presented and discussed. The second part contains a detailed description of the electron accelerator which is used in the laboratory as a photon and X-ray source. This accelerator has been upgraded from 1 MeV to 2 MeV. ESRO

N70-23818# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
THE RULE OF REVERSIBILITY ON BACKSCATTERING OF PROTONS ON COPPER MONOCRYSTALS [DIE REVERSIBILITAETSREGEL BEI DER RUECKSTREUUNG VON PROTONEN AN KUPFEREINKRISTALLEN]
B. M. U. Scherzer (Ph.D. Thesis—Munich Univ.) Jun. 1969 38 p refs In GERMAN; ENGLISH summary
(IPP-2/80) Avail: CFSTI

The applicability of the rule of reversibility to anistropic Rutherford backscattering of 60 and 120 keV protons from Cu monocrystals was investigated at various temperatures. This was done by measuring the angular and energy distributions of the backscattered hydrogen atoms, both for incidence and observation at small angles to the (110) direction. Contour line plots of the backscattering minima were made for the various depths of backscattering. The closer the backscattering is to the surface and the higher the primary energy and the lower the temperature, the better is the agreement between the channeling and blocking minima. Deviations for backscattering from large depths can be ascribed to energy losses of the protons in the lattice. The half-widths for the channeling and blocking effects can be determined from the backscattering minima. At all temperatures the half-width for the blocking effect is a factor of $\sqrt{2}$ larger than that for the channeling effect. They are both smaller than the Lindhard angle and depend on the energy as $1/\sqrt{E}$. The backscattering minima are noticeably affected by radiation damage. Author (ESRO)

N70-23859# Commissariat a l Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ENERGY LOSSES, RANGE AND BREMSSTRAHLUNG YIELD FOR 10 keV TO 100 MeV ELECTRONS IN SOME SIMPLE ELEMENTS AND CHEMICAL COMPOUNDS [PERTES D'ENERGIE, PARCOURS ET RENDEMENT DE FREINAGE POUR LES ELECTRONS DE 10 KEV A 100 MEV DANS LES ELEMENTS SIMPLES ET QUELQUES COMPOSES CHIMIQUES]
Lucien Pages, Evelyne Bertel, Henri Joffre, and Loadamas Sklavenitis Jan. 1970 142 p refs In FRENCH; ENGLISH summary
(CEA-R-3942) Avail: CFSTI

The study of tissue equivalent materials for dosimeters necessitates the determination of certain physical characteristics of the mixtures. The energy losses by ionization and bremsstrahlung were calculated separately. The energy losses by ionization were calculated from the Bethe slowing-down theory, and in order to take account of the density effect, the usual empirical functions were avoided by using the basic functions established by Fermi. The energy losses by bremsstrahlung emission were calculated according to the formulas proposed by Koch and Motz. A computer program was developed and written in FORTRAN 4 for an IBM 360-91. This program made it possible to calculate the stopping powers, the range, and the bremsstrahlung yields of electrons, with energy between 10 keV and 100 MeV, particularly for all the elements capable of interfering in the development of tissue equivalent mixtures. Author (ESRO)

N70-23864# Kansas Univ., Lawrence. Nuclear Physics Lab.
MO TRANSITIONS IN SPHERICAL NUCLEI
Donald A. Bell and J. P. Davidson [1968] 74 p refs
(Contract AT(11-1)-1120)
(COO-1120-87) Avail: CFSTI

For light even-even nuclei, A < 40, the 0(-) to 0(+) transition probability was calculated for the (gamma,gamma), (gamma e), and (ee) processes. The assumption is made that the 0(-) state decays through the giant dipole states. The resonance states were calculated according to Brown and Bolsterli particle–hole theory. This was done in both the Tamm–Dancoff (TD) approximation and the random phase approximation. In the TD approximation, various potentials were used to calculate the energy levels and eigenvectors to determine the potential dependence in the transition probability. Results for the 0-16 state at 10.937 MeV in O-16 gives a value of 1 × .00001 for the branching ratio B(MO,gamma gamma)/B(M1). The possibility of measuring the (gamma e) and (ee) processes in O-16 is more or less excluded by the exceedingly small value of the branching ratio B(MO, gamma e or ee)/B(M1). The results of calcualtions on C-12, Si-28, and S-32 are also presented. Author (NSA)

N70-23896# Northwestern Univ., Evanston, Ill.
SPECTROSCOPY OF f-p SHELL NUCLEI BY (d,n) REACTIONS
Richard Gerald Couch Jun. 1970 105 p refs
(TID-25246) Avail: CFSTI

The proton levels of 1f-2p shell nuclei were studied using the (d,n) reaction. A 10-MeV pulsed deuteron beam was used for (d,n) reactions on Fe-54,56, Co-59, and Zn-64,66,68. Neutron spectra and angular distributions were measured using scintillation detectors. Energy levels and level properties were determined for Co-55,57, Ni-60, and Ga-65,67,69. These levels were compared with previous data from (He-3,d) reactions. NSA

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N70-22541# Cornell Univ., Ithaca, N.Y. Lab. of Plasma Studies.
RELATIVISTIC FIELDS DUE TO A PARTICLE IN A GROUNDED CYLINDRICAL BOX Technical Research Report
Richard L. Liboff Jun. 1969 50 p refs
(Contract N00014-67-A-0077-0002)
(AD-698315; LPS-28) Avail: CFSTI CSCL 20/3

The exact relativistic fields inside a perfectly conducting, closed, grounded cylindrical box of finite length, which are due to a charged particle moving down the axis in vacuum are obtained. This permits construction of the solution for a line segment propagating down the axis, and the return surface-current. The fields are shown to be causal so that no field is present before the light front. The technique of solution employs superposition of Lorentz transformed fields of the positive and negative images. The initial condition that there be no field in the box at time t = 0 is satisfied by adding a superposition of the cavity modes to the inhomogeneous solution. The fields and energy in the wake are also found. Author (TAB)

N70-22581# Princeton Univ., N.J. Plasma Physics Lab.
TRANSPORT PROCESSES IN TOROIDAL SYSTEMS
L. Kovrizhnykh Oct. 1969 42 p refs Transl. into ENGLISH of Akad. Nauk SSSR, Fiz. Inst. Reprint No. 98 In ENGLISH and RUSSIAN
(Contract AT(30-1)-1238))
(PB-187710T; MATT-Trans-82) CSCL 18A

Expressions are presented for fluxes of particles and energy across a magnetic field in toroidal magnetic traps of various types (tokamak, levitron, stellarator, and a corrugated torus). Cases of both completely and weakly ionized plasma are investigated. From the expressions obtained it follows that at sufficiently low collision frequencies consideration of toroidality leads to an appreciable increase in the diffusion and thermal conductivity coefficients by comparison with straight systems. Here it turns out that there is a range of parameters (low collision frequencies or sufficiently large electric fields) where the transport coefficients do not depend on the magnitude of the magnetic field in general. Author (USGRDR)

N70-22591# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A THEORY OF AN EROSION PLASMA SOURCE

V. V. Balyberdin et al 18 Aug. 1969 17 p refs Transl. into ENGLISH from Samoletostroenie i Tekhn. Nozdushnogo Flota (USSR), no. 11, 1967 p 35–41
(AD-698536; FTD-MT-24-173-69) Avail: CFSTI CSCL 20/9

The paper covers theoretical research on the process of electrodynamic acceleration of plasmoids, taking into account the thermal inertia of mass liberation and losses of energy due to plasma heatup and electrode erosion. The results obtained permit estimating the thrust and energy coefficients of the conversion of electrical energy into plasma flow enery. Author (TAB)

N70-22655 West Virginia Univ., Morgantown.
THE FLOW OF A TWO-SPECIES PLASMA IN A CYLINDRICAL TRAVELING WAVE ACCELERATOR
Fred Kazuo Enseki (Ph.D. Thesis) 1969 150 p
Avail: Univ Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-20704

The purpose of this paper is to determine the species motions for the case of a fully ionized gas composed of electrons and singly ionized, positive ions. Assuming inviscid and non-heat conducting species flows and applied frequency small compared to the plasma collision frequency, the species forms of the classical MHD equations are analyzed by employing a small perturbation expansion. Momentum and energy transfer terms based on a binary collision model are used in the species momentum and energy equations, respectively. All fluid dynamic variables, with the exception of the azimuthal velocity components, are expanded in even powers of the small interaction parameter. The electromagnetic variables and the azimuthal velocity components are expanded in odd powers of the perturbation parameter. The zero order solutions are for the simple case of cylindrical channel flow without interaction. Dissert. Abstr.

N70-22716# Sandia Corp., Albuquerque, N.Mex.
RADIATIVE ENERGY LOSSES FROM A HYDROGEN PLASMA WITH IMPURITIES
M. D. Olman Oct. 1969 22 p refs
(SC-RR-69-758) Avail: CFSTI

The development of large magnetohydrodynamic codes requires the inclusion of the effects of radiative energy losses, including the possible effects of impurities. A computer routine was written which calculates plasma energy losses caused by bremsstrahlung, recombination, and resonance radiation. Either the Saha or corona model is used to calculate the ionization equilibrium of the impurity atoms. The major assumptions, method of calculation, and test results are discussed. Author (NSA)

N70-22729 Mississippi State Univ., State College.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE COLLISIONLESS PLASMA SHEATH
Hideo Yamada (Ph.D. Thesis) 1969 129 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-19617

Plasma sheath equations were derived under the following assumptions: (1) one-dimensional, (2) collisionless, (3) Maxwellian velocity distributions of charged particles at the sheath edge, (4) perfectly conducting sheath plate, (5) two species gas (electrons and ions), (6) static, and (7) no magnetic field. Similarity transformations were found to exist between the sheath of positive plate with parameter alpha equal to ratio of electron temperature and ion temperature and the sheath of negative plate with parameter 1/Z squared sub alpha, where Z sub i is the number of net charges on an ion. An abnormal region near the sheath edge, which was attributed to classical sheath assumptions made it impossible to evaluate the nondimensional potential gradient at an arbitrary location in the sheath. Several examples of the comparison between the theory and experiment are presented. The results were observed to agree more for the sheath of positive plate than for the sheath of negative plate. Dissert. Abstr.

N70-22737*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STABILITY OF TANGENTIAL DISCONTINUITIES
T. G. Northrop and T. J. Birmingham Mar. 1970 15 p refs Submitted for publication
(NASA-TM-X-63853; X-641-70-69) Avail: CFSTI CSCL 20I

The MHD stability of tangential discontinuities is considered. Discontinuities are treated as structured forms rather than as sharp breaks in the magnetic field. An unfamiliar form of the MHD energy principle is applied, and stability is proved provided that there is no fluid flow tangent to the discontinuity plane. Perturbations which simply transform the system from one equilibrium to another are neutrally stable. Using comparison theorems, it is concluded that the observed stability of tangential forms in solar wind implies near isotropy of the particle pressure. Author

N70-22838 Dartmouth Coll., Hanover, N.H.
COLLISIONAL DAMPING OF WAVES IN PLASMAS
John Barton Mc Bride (Ph.D. Thesis) 1969 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-6047

The collisional damping of small amplitude, electron waves in fully ionized Maxwellian plasmas is considered. Dispersion relations, and collisional damping rates are derived for the longitudinal plasma oscillation, linearly polarized transverse mode, and circularly polarized modes using the Landau equation, and its relativistic generalization, the Beliaev-Budker equation. The treatment is nonrelativistic, and relativistic effects are included to lowest order by treating the electrons relativistically. The calculations are done for no external fields, and then for a uniform magnetic field. The results include first order thermal corrections, and products of thermal by relativistic corrections are neglected. The procedure is to evaluate the electron current density using an approximate solution to the linearized kinetic equation. When more convenient, an equivalent moment equation approach is used. Dissert. Abstr.

N70-22925 California Univ., San Diego.
PLASMA TRANSPORT IN A MAGNETOPLASMADYNAMIC ARC
Robert Edward Kribel (Ph.D. Thesis) 1968 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-6428

A modified magnetoplasmadynamic (MPD) arc has been operated in a pulsed mode to permit internal probing of the arc region. The arc attains steady state operation which strongly resembles the behavior of the more conventional continuous MPD arcs. Spatial surveys with magnetic probes and small Rogowski coil probes show the current distribution to have the form of a well defined radial spoke which rotates azimuthally. The rotation frequency is typically about 40 kc with Argon propellant. Observations with double plane Langmuir probes indicate that the rotating current spoke corresponds to an actual plasma rotation. The plasma density within the spoke is at least an order of magnitude higher than it is at other azimuthal positions. Dissert. Abstr.

N70-22928# Princeton Univ., N.J. Plasma Physics Lab.
CONVECTIVE AND OSCILLATORY LOSSES IN Q-MACHINES
Francis F. Chen Oct. 1969 15 p refs Presented at the Intern. Conf. on Phys. of Quiescent Plasma, Paris, 8–13 Sep. 1969
(Contract AT(30-1)-1238)
(MATT-717; CONF-690923-3) Avail: CFSTI

Anomalous transport in Q machines is caused partially by dc convection and partially by oscillations. Pure drift waves can account for only a small radial loss because their amplitude is small at the boundary. Large nonlinear oscillations can cause a large loss by increasing the dc convection. Turbulent fluctuations can carry plasma across the boundary easily and also cause a large loss when the spectrum extends to low frequencies (not necessarily dc).

An effort was made to confirm these conclusions by direct measurements of the radial flux by means of a plasmaeater, but the data did not give self-consistant results. Author (NSA)

N70-23003# Institut fuer Plasmaphysik G.m.b.H., Garching (West Germany).
ON THE POTASSIUM CONFINEMENT IN THE GARCHING OCTOPOLE WV
F. Rau Jun. 1969 25 p refs
(IPP-2/78) Avail: CFSTI

The primary losses are caused by direct loss of the gyrating ions at the support surfaces and the corresponding calculated confinement time T sub s1 is independent of the density. Secondary losses, corresponding to tau sub s2, can be caused by an azimuthal density gradient. Depending on its direction, secondary losses are either towards the outer walls or towards the rings, the direction of the magnetic field being given. Using experimental data, an experimental confinement time tau = 0.2 s as well as loss times s1 = 0.5 to 0.8 s and s2 = 0.6 to 0.04 s were found for a potassium plasma, in the purely meridonal magnetic field of the Octopole W V. The confinement properties of the Octopole appear to be governed by the presence of the ring supports, either predominantly by primary losses, if one assumes a strong sheath effect on the corresponding particle flux, or predominantly by secondary losses, if one neglects the sheath enhancement of the primary losses, or by any combination of primary and secondary losses. Author (ESRO)

N70-23020# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMODYNAMICS OF HIGH-TEMPERATURE GASES
V. V. Rybakov 15 Aug. 1969 118 p refs Transl. into ENGLISH from the Russian Report
(AD-698526; FTD-HT-23-113-69) Avail: CFSTI CSCL 20/9

The book is concerned with the thermodynamics of high-temperature gases of various densities. The behavior in the low-density range in the presence of electric and electromagnetic fields is described by the method of phenomenological thermodynamics. In this case the state of the gaseous system is determined not only by the temperature of statistical particle distributions, but also by the thermodynamic temperature. This method has made it possible to obtain a closed (complete) system of equations for determining the state of the gas and the statistical temperatures. The methodology for evaluating the system of equations obtained is also presented in the book. The characteristic feature of the medium gas density range is the existence of thermodynamic equilibrium. In principle, the description of this region does not differ from the one usually used. The chapter dealing with calculations for gas of medium density is primarily methodological. Author (TAB)

N70-23229# European Space Research Organization, Paris (France).
COLLISION-FREE SHOCKS IN THE LABORATORY AND SPACE
Dec. 1969 241 p refs Proc. of the ESRIN Study Group, Frascati, Italy, 11–20 Jun. 1969
(ESRO-SP-51) Avail: CFSTI

Conference papers on collision-free shocks are presented. For individual titles, see N70-23230 through N70-23249.

N70-23230# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Plasmaphysik.
PRESENT STATE OF EXPERIMENTAL STUDIES ON COLLISIONLESS SHOCK WAVES
E. Hintz *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 1–10 refs (See N70-23230 10-25)
Avail: CFSTI

An overall survey of the important and generally accepted conclusions concerning collisionless shock waves and describes the experimental difficulties often encountered is presented. The structural phenomena expected with both small and large amplitude waves are also reviewed. Collective dissipation processes particularly in resistive perpendicular shocks at Alfven Mach numbers between 2 and 3 are discussed and the results of plasma wind tunnel experiments are summarized. ESRO

N70-23231*# TRW Systems Group, Redondo Beach, Calif. Space Sciences Lab.
THE FINE STRUCTURE OF THE EARTH'S COLLISIONLESS SHOCK WAVE
R. W. Fredricks and F. L. Scarf *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 11–21 refs (See N70-23229 10-25)
(Contract NAS5-9278)
Avail: CFSTI CSCL 20I

Instruments aboard the eccentric earth-orbiter OGO-5 have provided high time resolution plasma diagnostics from which the gross and fine structure of collision-free shocks can be deduced. Several types of shock structures in the high beta high Mach number flows of solar wind plasma impinging upon the magnetospheric obstacles have been found. By far the most common structure is a large amplitude MHD pulse structure having a characteristic length of the initial gradient and trailing wavetrain corresponding to the electron inertial length. The dissipation mechanism in such shock structures is provided by electrostatic wave turbulence arising from current-driven electron-proton or proton-proton two stream instabilities which nonlinearly saturate. Nonlinear whistler mode waves also occur in some shock structures, but provide much less efficient dissipation or proton thermalization compared with that due to the electrostatic turbulence. Author (ESRO)

N70-23232# Los Alamos Scientific Lab., N. Mex.
OBSERVATIONS OF THE EARTH'S BOW SHOCK WAVE WITH THE VELA 4B SATELLITE
Michael D. Montgomery *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 23–34 refs (See N70-23229 10-25)
Avail: CFSTI

Concurrent measurements of electron and proton velocity distributions are presented which were obtained near the earth's bow shock by the electrostatic analyzer on the Vela 4B satellite. From these measurements the following results have been obtained: the proton temperature jump is usually 2 to 4 times greater than the electron temperature jump. The proton temperature downstream from the shock is nearly always greater than the electron temperature. Rapidly varying secondary maxima in the high velocity tail of the proton distributions just downstream from the shock are interpreted as evidence for interaction of the protons in the wings of the distribution with plasma waves. The distance required for the heating of electrons in the shock has been estimated from the detailed study of one crossing to be approximately 20–40 Debye lengths. This is interpreted as evidence for the shock being essentially electrostatic at the time of the observation. Author (ESRO)

N70-23235# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
LAMINAR THEORY OF PERPENDICULAR SHOCKS
H. Grad *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 47–56 (See N70-23229 10-25)
(Contract AT(30-1)-1480)
Avail: CFSTI

This review is confined to the theory of laminar shocks in which there is no reference to instabilities or turbulence. This restriction, plus the limitation to perpendicular shocks, limits the field to a small part of plasma shocks. Nevertheless, this restricted subject is sufficiently ramified to offer a very wide choice of physical mechanisms and a theory, which is discussed, that is far from complete. ESRO

N70-23236# Los Alamos Scientific Lab., N.Mex.
TWO-DIMENSIONAL NUMERICAL SIMULATION OF NORMAL COLLISIONLESS SHOCKS
R. L. Morse and C. R. Shonk *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 57–65 refs Sponsored by AEC (See N70-23229 10-25)
Avail: CFSTI

Analytical approaches to the calculation of collisionless shock waves are discussed. Difficulties prevalent in these calculations can be avoided by numerical simulation. Simulation is attractive since plasma particle interactions are simple and well known. In this model, ions move correctly under self-consistent fields. Electrons are treated as a massless, adiabatic fluid which moves so as to maintain charge neutrality to lowest order. Ion motion is non-adiabatic due to interaction with the turbulent fields in the plasma. Particle motion is in a plane perpendicular to the magnetic field. A suitable set of finite difference equations for the particle motion is proposed, and their solution by a 'particle-in-cell' technique is discussed. Results are presented for several cases of interest. Author (ESRO)

N70-23237# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
AN IMPROVED TWO-FLUID MODEL FOR PLASMA
Cathleen S. Morawetz *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 67–74 refs (See N70-23229 10-25)
Avail: CFSTI

Solving a two-fluid model of a plasma is considered. The equations used are found from Vlasov and Maxwell equations assuming that the current and charges are given by the corresponding integrals of the distribution functions, and that the displacement current and the total charge can be neglected. Author (ESRO)

N70-23238# Maryland Univ., College Park. Dept. of Physics and Astronomy.
DISSIPATION FROM INSTABILITIES IN COLLISIONLESS SHOCK WAVES
Nicholas A. Krall *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 75–88 refs (See N70-23229 10-25)
Avail: CFSTI

Instabilities, generated by multiple ion streams in a strong turbulent shock often provide enough dissipation to maintain a steady state plasma transition layer. A detailed summary of calculations of turbulent dissipation such as anomalous resistivity in ion dissipation is presented. ESRO

N70-23239# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
NUMERICAL INVESTIGATION OF CONDUCTIVITY OF A WEAKLY TURBULENT PLASMA USING QUASILINEAR THEORY
R. Chodura, G. Bardotti, and F. Engelmann *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 89–95 refs Prepared jointly with CNEN (See N70-23229 10-25)
Avail: CFSTI

In the theory of subcritical collision-free shock waves use has to be made of some kind of 'turbulent resistivity' in order to describe the dissipation of the kinetic energy of the instreaming plasma into thermal energy of the electrons. The theory of this turbulent resistivity was originally given under the assumption of cold ions which fairly simplifies the dispersion relation of the unstable waves. The critical drift velocity for the onset of a two-stream instability is of the order of the thermal electron velocity. The resonant region of waves and particles initially extends over a narrow portion of the flank of the electron distribution. However, it has been conjectured that owing to non-resonant diffusion, the resonance region might broaden after some time, leading to resonant diffusion also in parts of the body of the electron distribution. ESRO

N70-23240# United Kingdom Atomic Energy Authority, Culham (England).
REVIEW OF EXPERIMENTAL STUDIES OF COLLISIONLESS SHOCKS PROPAGATING PERPENDICULAR TO A MAGNETIC FIELD
J. W. M. Paul *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 97–129 refs (See N70-23229 10-25)
Avail: CFSTI

After an introductory discussion of the nature of collisionless shocks, an informal review of the current state of experimental studies and their relation to theoretical predictions is given. Consideration of the shock width parameter leads to the following classification for perpendicular shocks: (a) dispersive non-linear waves and shocks (i) non relativistic (ii) relativistic, (b) shock waves with beta sub 1. Author (ESRO)

N70-23241# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
INVESTIGATION OF ENERGY DISSIPATION IN COLLISIONLESS SHOCK WAVES BY LIGHT SCATTERING
M. Keilhacker *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 131–148 refs Prepared jointly with EURATOM (See N70-23229 10-25)
Avail: CFSTI

The scattering theory, important for the investigation of collisionless heating in shock waves by light scattering, is first briefly reviewed. The diagnostic technique is described, and the results obtained from the non-collective and also the collective scattering of laser light are given. ESRO

N70-23242# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Plasmaphysik.
LAMINAR THEORY OF OBLIQUE HYDROMAGNETIC WAVES
H. Kever *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 149–158 refs (See N70-23229 10-25)
Avail: CFSTI

The discussion on plane oblique hydromagnetic waves is limited to the following topics of oblique wave propagation: discussion of oblique and perpendicular waves, wave propagation in cold plasmas and propagation of wave groups along with dispersion relations and wave equations. ESRO

N70-23243# Texas Univ., Austin.
EXPERIMENTS ON OBLIQUE SHOCK WAVES
A. E. Robson *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 159–176 refs (See N70-23229 10-25)
Avail: CFSTI

This paper describes experiments for studying oblique shocks which, although more complex than perpendicular shocks yield more information about collisionless processes. The experiments cover the categories of curved magnetic pistons driven into stationary magnetized plasma and super-Alfvenic plasma streams directed at stationary magnetic obstacles. ESRO

N70-23244# Atomic Energy Commission Research Establishment, Riso (Denmark).
EXPERIMENTS ON COLLISIONLESS ELECTROSTATIC SHOCKS
H. K. Andersen, S. A. Andersen, V.O. Jensen, P. Nielsen, and N. D'Angelo *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 177–181 refs Prepared jointly with ESRIN (See N70-23229 10-25)
Avail: CFSTI

Using a magnetic nozzle, an attempt was made to observe the standing collisionless electrostatic shocks described by Tidman. The experiments failed to show collisionless shocks for Mach numbers up to about 3 and temperature ratios T sub e/T sub i of approximately 3. Author (ESRO)

N70-23245# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany). European Atomic Energy Community, Brussels (Belgium).

NON-LINEAR QUASI-NEUTRAL ELECTROSTATIC PLASMA WAVES AND SHOCK WAVES

Henri Tasso *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 183–189 refs Prepared jointly with EURATOM (See N70-23229 10-25)
Avail: CFSTI

For the stationary one dimensional Vlasov equation, quasi-neutrality is used instead of the Poisson equation. Solutions for the density as a function of the potential are obtained and the positiveness of the trapped particle distribution function in a potential interval is proved. The usefulness of the method for oscillating waves and shock waves is apparent. Author (ESRO)

N70-23246# Maryland Univ., College Park. Dept. of Physics and Astronomy.

A SURVEY OF LABORATORY DEVICES FOR PRODUCING COLLISION-FREE SHOCK WAVES

Alan W. De Silva *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 193–202 refs (See N70-23229 10-25)
Avail: CFSTI

Although satellite observations of the earth's bow shock give evidence of collision-free shock waves and laboratory experiments support the large body of theoretical work there have been few laboratory projects producing collision-free shocks in the strict sense because of difficulties with the electron collision frequency. The analysis of the shock is most easily carried out if the structure is a quasi-steady state. It is therefore desirable to make the shock tube very much larger than any expected shock structure, so as to allow a steady profile to form and to become well separated from the driving piston. Shock experiments can be classified as either moving plasmas or moving pistons. The magnetic piston experiments are surveyed in detail and special mention is made of the possible existence of steady state detached shocks in low density plasmas but it is concluded that it will now be necessary to study the plasma-vacuum interface and the complex phenomena occurring there. ESRO

N70-23247# European Space Research Inst., Frascati (Italy).

A PROPOSAL FOR A COLLISIONLESS SHOCK WAVE DEVICE

H.-J. Schneider-Muntau *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 203–206 (See N70-23229 10-25)
Avail: CFSTI

A proposal for building an apparatus to produce collisionless shock waves which will have some advantages in comparison with existing shock wave devices is presented. The proposal was calculated for the simulation of the bow shock of the earth, but collisionless shock wave experiments with this device in different parameter regimes can be performed. Calculations indicate that a plane plasma sheath accelerator energized by a line with low characteristic impedance can meet the requirements. The length of the line depends on the final velocity of the piston, the rise time, the required separation distance, and the dielectric material of the line. An obvious modification would be to replace the two plates of the line by three plates forming a Blumlein line. This would simplify the switching problem which is necessary to obtain a uniform and simultaneous breakdown. The device seems to be very suitable for the generation of high Mach number collisionless shock waves in magnetic fields of arbitrary direction. ESRO

N70-23248# United Kingdom Atomic Energy Authority, Culham (England).

STUDY OF TURBULENCE WITHIN A COLLISIONLESS SHOCK USING COLLECTIVE SCATTERING OF LIGHT

J. W. M. Paul, C. C. Daughney, and L. S. Holmes *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 207–227 refs (See N70-23229 10-25)
Avail: CFSTI

The currently accepted theories of collisionless shocks with low Alfven Mach number invoke ion wave turbulence to explain the resistive heating and the shock structure. These ion waves have fluctuating electric fields which scatter and consequently heat electrons, and fluctuating electron densities which can scatter light. This latter process was used to study the turbulence within these shocks. Measurements of a suprathermal level of ion wave fluctuations within the shock are presented and from these the energy in the turbulence and the effective collision frequency have been estimated. The latter is sufficient to explain the observed shock heating. Recent measurements of the spectral profiles of the light scattered by these ion waves are also presented. The profiles demonstrate that the ion waves propagate in the direction of electron current with the ion wave phase velocity but are heavily damped. This damping results in many random changes of phase during an effective collision time. Author (ESRO)

N70-23249# United Kingdom Atomic Energy Authority, Culham (England).

TURBULENT PROCESSES IN A PLASMA SHOCKFRONT

A. G. Eskov, R. Kh. Kurtmullaev, A. I. Malyutin, B. I. Pilskii, and V. N. Semenov *In* ESRO Collision-Free Shocks in the Lab. and Space Dec. 1969 p 229–243 refs (See N70-23229 10-25)
(CTO/628) Avail: CFSTI

The microfluctuations of the electromagnetic field and the electric and magnetic field distribution in a shock wave front are investigated. When n>n sub c electric field oscillations occur in the wavefront. Their frequencies and wavelengths are not in conflict with the assumption of their ion-acoustic nature. The character of the electric and magnetic field distributions, the fluctuation amplitude and the measured conductivity in the wave, agree with the assumption of the predominance in the wavefront of a resistive dissipation due to 'friction' of the electrons against the ion-acoustic waves. It is shown that when M>M sub c the oscillation spectrum and the macroscopic electric field distribution in the wavefront change. The experimental results agree with the assumption for M>M sub c, of a viscous dissipation mechanism due to the excitation of electromagnetic oscillations in colliding ion fluxes, associated with heating of the ions. Author (ESRO)

N70-23283*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

OPTIMIZATION OF A LINEAR INDUCTIVE MHD MACHINE CONSIDERING THE LONGITUDINAL END EFFECT [OPTIMIZATSIYA LINEYNOY INDUKTSIONNOY MGD MASHINY S UCHETOM PRODOLNOGO KRAYEVOGO EFFEKTA]

Ya. Ya. Valdmanis 11 Aug. 1969 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk Latv. SSR, Ser. Fiz. i Tekhn. Nauk (Riga), no. 4, 1968 p 120–126
(Contract NAS7-100)
(NASA-CR-109333) Avail: CFSTI CSCL 20I

By means of utilizing the variation method, a distribution of the current load in a linear induction MHD machine was found in which the efficiency has a maximum value. The dependencies of the optimal efficiency on the relative length of the MHD machine are presented. The investigation was conducted both for the pumping and the generator regimes (operating conditions). Author

N70-23377*# Stanford Univ., Calif. Inst. for Plasma Research.

PARAMETRIC WAVE AMPLIFICATION AND MIXING IN THE IONOSPHERE

K. J. Harker and F. W. Crawford Dec. 1969 37 p refs
(Grants NGL-05-020-176; NSF GA-4266)
(NASA-CR-109362; SU-IPR-349) Avail: CFSTI CSCL 20I

An analysis is presented of nonlinear interaction between right- or left-hand polarized transverse electromagnetic waves and longitudinal (Langmuir) plasma waves propagating in the ionosphere.

The object is to determine the feasibility of observing parametric amplification or frequency mixing due to such interactions, using ground based transmitters and receivers. It is shown theoretically that wave coupling should occur in three situations: first, where the highest frequency component is the plasma wave and the two lower frequencies are right- and left-hand polarized waves, respectively; second, where the highest frequency component and one other are right-hand polarized and the third is a plasma wave, and third, where the highest frequency component and one other are left-hand polarized and the third is a plasma wave. The first case shows the weakest coupling, and seems unlikely to be observable. The second and third give rise to somewhat stronger effects, but for typical transmitter and ionospheric parameters suggest the necessity of measuring increments in wave amplitudes due to nonlinear coupling only of order 0.01 percent. Author

N70-23473# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
MULTICHANNEL ENERGY ANALYSIS OF THE ION FLUX FROM A THETA PINCH [VIELKANAL-ENERGIEANALYSE DES IONENFLUSSES AUS EINEM THETA-PINCH]
G. Becker Jul. 1969 45 p refs In GERMAN; ENGLISH summary
(IPP-1/98) Avail: CFSTI

A new 10-channel energy spectrometer was used to analyze the ion flux parallel to the axis of a linear theta pinch. Time resolved energy spectra were obtained from each discharge. There was experimental evidence that neutral gas, electrons, and magnetic field influence the ion flux. They distorted the distribution especially at the lower energy limit of the instrument range and gave ion fluxes that were too small by more than a factor of 10. The measured energy spectra were wide and without ion groups. The time behavior of the neutron flux and ion flux were correlated in the range 1–10 keV. The results of the measurements were incompatible with relation due to Coulomb collisions. This may be due to an anomalously fast relaxation caused by a microinstability. The time variations of the measured ion fluxes can be explained for all E of the instrument range. Author (ESRO)

N70-23489# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
LOW FREQUENCY INTERCHANGES
Guenther Otto Spies Jul. 1969 35 p refs Presented at the 3d European Conf. on Controlled Fusion and Plasma Phys., Utrecht, 1969
(IPP-6/76) Avail: CFSTI

Unstable low frequency interchanges, i.e. electrostatic modes with growth rates of the guiding center drift frequencies are shown to exist in a wide class of self-consistent low beta guiding center equilibria. This class is defined by some restrictions, the most important of which are symmetry, vanishing of the electric field, and stability on the faster timescale of the longitudinal guiding center motion. Open-ended, as well as toroidal configurations, with or without a rotational transform, and arbitrarily anisotropic distribution functions are admitted. Some relationships to the MHD description are derived for the equilibria subclass having isotropic distribution functions. The well known interchange stability criterion of the guiding center theory, is shown to be identical with the wellknown V-criterion of the MHD theory. Since low frequency interchange stability criterion turns out to be a more restrictive requirement than interchange stability, the confusion arising from earlier work is removed. Author (ESRO)

N70-23574# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
ON THE EXISTENCE OF TOROIDAL MAGNETOHYDROSTATIC EQUILIBRIA WITHOUT ROTATIONAL TRANSFORM [UEBER DIE EXISTENZ TOROIDALER MAGNETOHYDROSTATISCHER GLEICHGEWICHTE OHNE ROTATIONSTRANSFORMATION]
Dietrich Lortz Jun. 1969 28 p refs In GERMAN; ENGLISH summary
(IPP-6/75) Avail: CFSTI

The magnetohydrostatic boundary value problem is investigated for a toroidal boundary surface T which is symmetric with respect to a plane, but which need not be continuously symmetric. The existence of an equilibrium solution is proved for the boundary condition that the magnetic field B be tangential at T. The pressure, as a sufficiently smooth function and azimuthal magnetic flux, can be chosen arbitrarily. Author (ESRO)

N70-23788# Montpellier Univ. (France). Department de Physique Mathematique.
COLLECTIVE OSCILLATIONS OF A RELATIVISTIC RADIATING ELECTRON PLASMA
Remi Hakim and Andre Mangeney (Observatoire de Meudon) Jan. 1970 43 p
(PM/69/3) Avail: CFSTI

The modified Vlasov equation is applied to the study of the dispersion relations of a relativistic radiating electron gas. The cases of supraluminous and suprathermal waves are dealt with. It is found that the effect of radiation is a negligibly small damping except for longitudinal supraluminous modes which are strongly damped. The stream instability is also studied and it is shown that the more relativistic a beam is, the more unstable it is. Author

N70-23898# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
INDUCTION VELOMETRY IN SHOCK WAVE OF PARTIALLY IONIZED GAS
G. Kamimoto and M. Nishida 27 Aug. 1969 20 p refs
(CP-27) Avail: CFSTI

Theoretical and experimental studies are described for an induction velometer in a shock wave of a partially ionized gas. The induced potential gradient profile across the shock is obtained with an assumption that the velocity of the charged particles is given by Mott-Smith's result. The calculated result of the induced potential gradient shows that it is not proportional to the velocity of the charged particles since eddy currents are induced owing to the existence of non-uniform velocity through the shock. The induced potential gradient is measured across the shock produced by a shock holder and is compared to the theoretical result. The experimental result shows that the charged particles follow the Rankine-Hugoniot relation in the velocity. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N70-22534# Air Force Cambridge Research Labs., Bedford, Mass.
COMPRESSIBILITY AND POLYMORPHISM OF SOLIDS Physical Sciences Research Papers
Johannes N. Plendl and Peter J. M. Gielisse Oct. 1969 32 p refs
(AD-698331; AFCRL-PSRP-395; AFCRL-69-0429) Avail: CFSTI CSCL 20/12

The compressibility of solids is expressed in terms of fundamental physical quantities in relation to the energy of an electron in the L-shell orbital. When the concept of apparent valency z sub a = (rho)z, the product of classical valency (z) and the ratio (rho) of the atomic coordinations of two successive polymorphs is used, the formula becomes generally applicable. As a result, the structure of each substance under ambient conditions can be classified as being either in the reduced, basic or elevated state. This allows the prediction of volumetric compressibility data from pertinent atomic data and physical constants as well as a qualitative prediction of possible structural modifications. The relationship between the damping parameter of a solid and the radius ratio is

shown to be useful in differentiating between the various possible structural modifications under a given set of pressure and temperature conditions. Author (TAB)

N70-22561# Illinois Univ., Urbana. Materials Research Lab.
MATERIALS SCIENCES RESEARCH Annual Technical Report, 1968–1969
1 Jan. 1970 193 p refs
(Contract ARPA SD-131)
(AD-698317) Avail: CFSTI CSCL 11/7

Brief summaries are given of the status and results of ARPA and AEC supported research programs at the Univ. of Illinois Materials Research Laboratory in the areas of cryogenics, crystallography, spectroscopy, metal physics, superconductivity, semiconductors, solid state physics and electronics, phase studies, high-pressure research, radiation damage, and related topics. A complete listing of published papers and theses is included. TAB

N70-22589# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center.
THE 2-6 SEMICONDUCTING COMPOUNDS DATA TABLES
Meta Neuberger Oct. 1969 168 p refs
(Contract F33615-68-C-1225)
(AD-698341; S-11) Avail: CFSTI CSCL 20/12

The tables include the most reliable information available to date for the mechanical, crystallographic, physical, thermal, magnetic, electronic and optical properties of each of the 2-6 binary semiconducting compounds. Author (TAB)

N70-22616# Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.
A STUDY OF THE INTERACTION BETWEEN MAGNETIC FLUXOIDS AND CRYSTAL DEFECTS IN TYPE 2 SUPERCONDUCTORS Informal Progress Report
E. J. Kramer 31 Oct. 1969 12 p refs
(Contract AT(30-1)-4060)
(NYO-4060-2) Avail: CFSTI

The apparatus for measurements of stress relaxation by plastic flow in lead alloy crystals at 4.2 K was constructed and calibrated. Theoretical studies aimed at a unified treatment of both surface and bulk pinning are reviewed. A brief account of the most important elements of a model that accounts successfully for the initial experimental results is given. Preliminary results on niobium single crystals with flat surfaces, which tend to support the proposed model, are presented. NSA

N70-22622# South Carolina Univ., Columbia. Dept. of Physics.
OPTICAL AND MAGNETIC RESONANCE STUDY OF TRANSITION METAL MIXED CRYSTALS Final Report, 1 Jul. 1966–30 Jun. 1969
Charles P. Poole, Jr. 1 Oct. 1969 72 p refs
(Contract AF-AFOSR-1139-66)
(AD-698840; AFOSR-69-2789TR) Avail: CFSTI CSCL 20/12

The report covers research carried out on several mixed-crystal systems. (1) Manganese spinels were studied over the entire concentration range of (Mg,Mn)Al2O4. The electron spin resonance (ESR) spectrum arising from isolated Mn+2 ions at low concentration was characterized by a narrow -1/2 (arrow) 1/2 sextet and four other broader overlapping fine structure sextets. (2) The Anderson model for exchange narrowing was solved for spins I = 1, 3/2, 2, 5/2 and the results employed to explain the spinel data. (3) Single crystals of chromia alumina were studied at about 50 and about 75 mole per cent chromia. The former exhibited typical ruby D-term anisotropies, while for the latter sample an isotropic spectrum arose from exchange narrowing. (4) An optical and ESR study of Cu+2 in turquoise was carried out and correlated with crystal field theory calculations. (5) A systematic treatment for the calculation of crystal field potentials was formulated, and a number of practical formulae for commonly occurring symmetry environments were calculated. (6) Mossbauer double resonance with the simultaneous application of optical, NMR and ESR signals was analyzed, and a prediction was made of the expected spectra. (7) The spin orientation in copper Tuttons salts was calculated for the minimum energy state. TAB

N70-22650# Los Alamos Scientific Lab., N.Mex.
ELECTRON MECHANISM OF SUPERCONDUCTIVITY IN SEMICONDUCTORS AND SEMIMETALS
B. T. Geilikman and V. Z. Kresin [1968] 4 p refs Transl. into ENGLISH from Fiz. Tekhn. Poluprov. (USSR), v. 2, 1968 p 784–787
(LA-4104-TR) Avail: CFSTI

A discussion of the possibility of an electron mechanism of superconductivity in semiconductors, semimetals, and molecular crystals is presented. Author (NSA)

N70-22660 Connecticut Univ., Storrs.
RESIDUAL RESISTIVITY ANISOTROPY AND SUPERCONDUCTING CRITICAL FIELD CURVE OF IMPURE TIN
Frederick Vincent Burckbuchler (Ph.D. Thesis) 1968 158 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-2103

Measurements were made of the orientation and electrical resistivities at 4.2, 77, and 273 K of single crystal tin samples containing Cd, In, Sb, and Zn impurity up to 2.5 atomic percent. The superconducting transition temperature, the slope of the critical field curve, and the zero temperature critical field were measured for these impure samples relative to pure tin. The anisotropy of the residual resistivity is found to be dependent on impurity type. Beginning with a nearly free electron view of the Fermi surface in tin, a qualitative discussion of these results is offered in terms of small angle scattering assisted by Bragg scattering. The observed impurity and temperature dependences are in reasonable agreement with the current theory of the superconducting sheath state. Dissert. Abstr.

N70-22664 Stanford Univ., Calif.
DEFORMATION AND DISLOCATION DYNAMICS IN SILICON SINGLE CRYSTALS
Thomas Alan Taylor (Ph.D. Thesis) 1968 201 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-8279

Data are presented characterizing the deformation behavior of silicon single crystals at temperatures above 850 C, and in the stress range of 200 to 1200 psi. Silicon was found to exhibit a logarithmic creep behavior below about 1000 C, while steady state creep was found above 1000 C. The activation energy for the creep process was found to be approximately 44 kcal/mole near 900 C and decreased to 39 kcal/mole near 1200 C. In addition, static recovery experiments were carried out at 850 to 1000 C and an activation energy of 46KCAL mole was found. The temperature dependence results, combined with observations of dislocations using transmission electron microscopy and chemical etch-pitting techniques suggest that the rate controlling process throughout both logarithmic and steady state creep, is dislocation glide. Dissert. Abstr.

N70-22701 University of Southern Calif., Los Angeles.
MACROSCOPIC CONFIGURATION OF MAGNETIC FIELDS AND ELECTRIC CURRENTS IN TYPE II SUPERCONDUCTORS
Christopher Teh-Min Chang (Ph.D. Thesis) 1968 207 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-5045

According to prevailing views, a critical current density is attained in type 2 superconductors when the Lorentz force density equals the pinning force density due to defects and impurities. Evidence is presented showing that the pinning force density increases as magnetic field intensity increases when field intensity is much less than the upper critical field for bulk superconductivity.

The magnetic behavior of simulated infinite slabs constructed with Nb3Zr ribbon and wire in magnetic fields parallel to the surfaces of the slab and perpendicular to the induced and conduction currents is extensively studied. Dissert. Abstr.

N70-22708# Los Alamos Scientific Lab., N.Mex.
THE TACS1 PROGRAM
Charles L. Wilson, S. John Brient, and Fred L. Cornwell 27 Jun. 1969 350 p refs
(Contract W-7405-eng-36)
(LA-4205) Avail: CFSTI

The TACS1 (Transport and Charge Storage) program is a general purpose program designed to calculate electrical charge transport and charge storage effects in one dimensional semiconductor structures of silicon and germanium. Electrostatic potentials and hole and electron distributions are calculated as functions of distance; certain integral parameters such as currents, voltage sensitivity of stored charge, and recombination-generation effects are also calculated. The program uses Fermi-Dirac statistics throughout; the physical effects of impurity scattering and of electric fields on mobilities are also included. Recombination-generation effects include recombination through a monovalent Shockley-Read center, secondary ionization (avalanche), and Zener tunneling. The program is written in FORTRAN IV for the CDC 6600 computer. Author (NSA)

N70-22802# Columbia Univ., New York. Dept. of Mechanical Engineering.
THEORETICAL STUDIES OF DISLOCATION BEHAVIOR IN CRYSTALS Final Report
W. T. Sanders 24 Sep. 1969 5 p
(Grant AF-AFOSR-1098-66)
(AD-698843; AFOSR-69-3103TR) Avail: CFSTI CSCL 20/2

The ultimate objective of this study is the determination of the static and dynamic properties of dislocations and dislocation arrays through the analysis of realistic discrete (atomistic) models of crystals. An intermediate objective, and the primary goal of this program, was to gain an understanding of the possibilities and limitations of such models through the investigation of a series of simplified forms of increasing complexity. Author (TAB)

N70-22807# Texas Univ., Austin. Physics Dept.
A COMMENT ON THE DEFORMATION POTENTIAL IN ULTRASONIC ATTENUATION
J. D. Gavenda [1969] 6 p refs Sponsored by NSF
Avail: CFSTI

It is pointed out that Kleinman's free-electron deformation potential approximation is not equivalent to the method used by Pippard in calculating ultrasonic attenuation in metals. The methods are compared in terms of "free electron" and "band structure" contributions to the deformation energy. Author

N70-22937# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center.
MAGNESIUM OXIDE
M. Neuberger and D. B. Carter Oct. 1969 106 p refs
(Contract F33615-68-C-1225)
(AD-698343; EPIC-DS-163) Avail: CFSTI CSCL 11/2

A wide range of electrical and optical properties are covered in these data sheets on magnesium oxide. Particular emphasis has been placed on the dielectric properties and the energy band structure. A data table which includes the best available information on the crystallographic, thermal, mechanical, physical, electronic and photoemissive properties is included. Author (TAB)

N70-23023 Nevada Univ., Reno.
THE PERTURBED DIRECTIONAL CORRELATION OF Sc 44 WITHIN THE LATTICE OF FERROELECTRIC BARIUM TITANATE
James Clifford Glass (Ph.D. Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-6425

The static electric quadrupole interaction of the intermediate level of Sc within a polycrystalline source of barium titanate has been investigated using the technique of time-differential perturbed directional correlations. The unperturbed correlation was first investigated using a source of TiCl4 in 6N HCl. A half life of 153 nsec was found for the intermediate level of Sc. The anisotropy was found to be time independent, giving an unperturbed anisotropy of 0.069 + or − 0.005 when corrected for finite solid angle of the detectors. In the polycrystalline barium titanate source the anisotropy of Sc is found to have a somewhat damped oscillatory behavior with time. The time-differential attenuation factor as well as the time-integrated factor show that the spin of the intermediate level is I = 1. Dissert. Abstr.

N70-23098*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF NUCLEAR RADIATION ON A HIGH RELIABILITY SILICON POWER DIODE. 2: ANALYSIS OF FORWARD ELECTRICAL CHARACTERISTICS
Julian F. Been Washington Apr. 1970 27 p refs
(NASA-TN-D-5732; E-5296) Avail: CFSTI CSCL 20L

One hundred power diodes were irradiated in the NASA Plum Brook Reactor. The changes in forward electrical characteristics due to nuclear radiation were interpreted in terms of decreasing minority carrier lifetimes. The increase in forward voltage at high current densities was the most significant change. The pre- and post-irradiation data were analyzed in terms of n(+)-p-p(+)-type junction theory. The critical quantity was the ratio of the base width to the high-level diffusion length. Control of the ratio suggests a means of increasing the radiation tolerance of this type diode. The effects of spacecharge limiting were also considered. Author

N70-23269# Oxford Univ. (England). Dept. of Engineering Science.
MICROWAVE EMISSION FROM SEMICONDUCTORS
A. G. R. Evans Jun. 1969 193 p refs Sponsored partly by Sci. Res. Council
(Contract AF-EOAR-67-33)
(Rept-1079-69) Copyright. Avail: CFSTI

Experimental work is described directed at the understanding of microwave emission phenomena in indium antimonide and indium antimonide-nickel antimonide eutectic. The electrical properties and experimental techniques are described, and preliminary studies of the microwave emission from the eutectic showed similarities to that from InSb. Some emission characteristics occurred throughout the applied voltage pulse whereas others occurred in bursts, and it was shown that the latter were not associated with electro-acoustic domain propagation in the samples. Some of both kinds of characteristics can be accounted for by modifying the Steele theory for photoconductive mixing of band gap radiation. It was concluded that microwave detectors could be calibrated and infrared detectors made using the microwave emission from these materials. Author (ESRO)

N70-23326# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Center.
SEMICONDUCTORS
M. S. Sominskiy 14 Aug. 1969 417 p refs Transl. into ENGLISH of the book "Poluprovodniki" Leningrad, Nauka, 1967 p 1–440
(AD-698839; FTD-HT-23-1333-68) Avail: CFSTI CSCL 20/12

Contents: Introduction to semiconductor physics; Semiconductor materials and their properties; Certain technological expedients; Methods of measuring the principal quantities; and Semiconductor components and their application. TAB

N70-23329# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE ABSORPTION SPECTRA OF In-Sb-In-As SOLID SOLUTIONS WITH A VIEW TO BAND STRUCTURE
N. N. Sirota et al 13 Aug. 1969 7 p refs Transl. into ENGLISH from Inst. Fiz. Tuerdgo Tela i Poluprov. Akad. Nauk Belorussk. SSR, Khim. Svya v Poluprov i Termodinam. (Minsk), 1966 p 267–270
(AD-698525; FTD-HT-23-50-69) Avail: CFSTI CSCL 20/12

Absorption spectra of InSb-InAs solid solutions of varying compositions were measured at room temperature by using polycrystalline plates and films obtained by evaporation in vacuo on hot silicon. For the compositions of the central part of the state diagram, the absorption curves are shifted to the long wave-length region as compared with the initial components. The concentration dependence curves of the forbidden zone passes through a deep minimum. The values of the forbidden zone for the films are higher than those of plates. This phenomenon may be connected with different zone structures in the plate and films. Author (TAB)

N70-23365# Atomic Weapons Research Establishment, Aldermaston (England).
THIN FILM CERMET STRUCTURES FORMED BY ION BOMBARDMENT
J. G. Perkins and P. T. Stroud Jan. 1970 14 p refs
(AWRE-O-9/70) Copyright. Avail: HMSO: 2s 6d; BIS $.60

Some experiments in which thin film layers exhibiting typical cermet characteristics have been formed by argon ion bombardment of metal-insulator-metal sandwich structures are described. The resistance of the insulating layer may be changed in a controlled manner by varying the dose of incident ions, and changes in resistance of eight orders of magnitude have been observed. A qualitative mechanism for the effect is suggested involving sputtering, and there is found to be reasonable agreement between experimental results and calculations based on current sputtering theories. Author

N70-23382# Royal Aircraft Establishment, Farnborough (England).
ELECTRON AND PROTON IRRADIATION OF SEMICONDUCTOR DEVICES [STRAHLENSCHADIGUNG VON HAIBLEITERBAUELEMENTEN DURCH ELEKTRONEN UND PROTONENSTRAHLUNG]
R. Bauerlein et al
Mar. 1969 19 p Transl. into ENGLISH from Raumfahrtforsch (Stuttgart), no. 1, 1968
(RAE-Lib-Trans-1347) Avail: CFSTI

The various phenomena and their physical causes which occur in semiconductor crystals are investigated by energetic-particle irradiation, and with experiments to investigate the radiation damage of solar cells and transistors. In addition, the radiation fluence for semiconducting devices in the radiation belt of the earth is calculated. The shielding of solar cells by cover glasses and of transistors by their cases was considered. The calculated degradation of solar cells and transistors is discussed for the satellite project AZUR and for a satellite in a synchronous orbit. Author

N70-23385# Recon, Inc., Tallahassee, Fla.
THE ANALYSIS OF COLD NEUTRON SPECTRA Final Report, 15 Dec. 1965 –1 Aug. 1969
Robert A. Kromhout and David F. Burch Oct. 1969 8 p
(Contract AF 19(628)-5806)
(AD-698772; AFCRL-69-0509; Rept-7) Avail: CFSTI CSCL 20/12

The report reviews briefly several methods for interpreting neutron scattering data in terms of center frequency of infrared and Raman Spectra. In addition, a determination of elastic constants and thermodynamic properties from dispersion data for crystals is discussed. Author (TAB)

N70-23388# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Department d'Etudes et de Recherches en Technologie Spatiale.
ELECTRONIC STATE OF A NEUTRAL VACANCY IN DIAMOND LATTICE
M. Djafari Rouhani and R. Schuttler Dec. 1969 12 p refs
(ONERA-DERTS-NT-02-13-69) Avail: CFSTI

The electron states of an isolated vacancy in diamond and silicon lattices were estimated using the theoretical model of Lannoo and Lenglart. It was found that the computed energy of formation was 5 eV for diamond and 4 eV for silicon. An extension of this model should include the lattice relaxation effect. ESRO

N70-23398*# Utah Univ., Salt Lake City. Dept. of Physics.
RADIATION KINETICS IN ELECTRONIC MATERIALS Semiannual Report
Abraham Sosin 15 Dec. 1969 7 p refs Prepared for JPL
(Contract NAS7-100; JPL-952384)
(NASA-CR-109365) Avail: CFSTI CSCL 20L

The degradation of minority carrier lifetime in solar cells irradiated in a space environment is studied to determine the manner of degradation, recovery, and redegradation for optimizing solar cell performance by formulating, and structuring kinetic models. The following facts are considered to be important: (1) For a large portion of the recovery from radiation damage, it is the short circuit current and not the concentration of defects which have a simple time dependence. (2) This is characterized by a dose independent annealing time at room temperature. The fraction of damage recovered depends on the dose. The larger the initial damage the smaller the fraction annealing. (3) The initial phase is followed by a second for which the effective recovery time increases with increasing initial damage. The reactions which are included in the reaction kinetic based computer program are listed. F.O.S.

N70-23438# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
THE FERMI SURFACE AND DELTA (K) OF SUPERCONDUCTING NB Technical Report
Margaret L. A. Mac Vicar Nov. 1969 17 p refs
(Contract NONR-3963(16))
(AD-698270; TR-10) Avail: CFSTI CSCL 20/12

Examination of available tunneling data from junctions oriented on single crystal niobium, shows that the observed superconducting energy gap values are grouped non-randomly in K-space. These groupings suggest a relationship between delta (K) and Fermi surface topology, and may suggest a significant role for phonon anisotropy. Author (TAB)

N70-23467# North Carolina State Univ., Raleigh.
A THEORETICAL MODEL FOR THE RESPONSE OF POLYCRYSTALLINE AGGREGATES UNDER HOMOGENEOUS MACROSTRESS Technical Report
Kerry S. Havner Nov. 1969 23 p refs
(Contract N00014-68-A-0187; ARPA Order 1090)
(AD-698279; TR-69-10) Avail: CFSTI CSCL 20/11

An integro-differential equation for the elastic-plastic response of a general, macroscopically homogeneous aggregate at small strain is developed. The microstress-strain constitutive equations are based upon the elastic compliance matrices of the individual crystal grains and a model of continuous crystalline slip (with the generalized Schmid-Taylor law of critical shear stresses on preferred slip planes expressed in terms of a strain-dependent hardening matrix). The corresponding theoretical model for analysis of aggregate behavior, under macroscopically homogeneous stress, is a further extension of Lins polycrystalline model for Taylor hardening of isotropic crystals and the writers equations for general hardening of an ordered aggregate. Consistent definitions of macrostrain rates and latent strain energy together with an exact proof of plastic strain rate normality are included. Author (TAB)

N70-23468# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
AN INVESTIGATION OF LOW ENERGY STRUCTURE IN NIOBIUM SINGLE CRYSTALS BY TUNNELING Technical Report
John W. Hafstrom and Robert M. Rose Nov. 1969 72 p refs
(Contract Nonr-3963(16))
(AD-698271; TR-11) Avail: CFSTI CSCL 20/12

An investigation of low energy superconductive tunneling into very pure single crystal niobium was performed. Lead and indium films, evaporated onto oxide barriers, were used as the probe. Evidence was found for a second energy gap in niobium at delta/10. The gap is temperature independent and agrees with various theoretical predictions. Additional new voltage structure is found in junctions formed with lead, indicative of tunneling processes occurring within the barrier. Various processes are proposed to explain the structure. Author (TAB)

N70-23476# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
EVIDENCE FOR A SECOND ENERGY GAP IN SUPERCONDUCTING NIOBIUM
John W. Hafstrom, Robert M. Rose, and M. L. A. Mac Vicar Nov. 1969 11 p refs
(Contract Nonr-3963(16))
(AD-698269; TR-9) Avail: CFSTI CSCL 20/12

Tunneling measurements on superconducting Nb single crystals indicate the existence of a second energy gap for superconductivity, about 1/10 the width of the larger one, and independent of temperature between 0.48 and 4.2 degrees K. Author (TAB)

N70-23497 Ohio State Univ., Columbus.
SIZE AND IMPURITY EFFECTS IN THE THERMAL CONDUCTIVITY OF VERY PURE GALLIUM
Robert Ivan Boughton, Jr. (Ph.D. Thesis) 1968 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-4850

The thermal conductivity of pure gallium single crystals was measured as a function of impurity concentration, size, temperature, and crystal orientation from 1.5 K to 4.2 K. The specimens were grown in the form of cylindrical rods ranging from 1/16 inch up to 3/16 inches in diameter in steps of 1/32 in. The crystal orientation of each sample was verified to be within 1/2 deg of the desired direction by means of the Laue back-reflection X-ray method. Measurements of the conductivity were performed using a standard single heater-dual thermometer technique. Carbon radio resistors were employed as thermometers and were calibrated against the saturated vapor pressure of liquid helium-4. The estimated overall accuracy of the experiments ranged from + or − 1 to + or − 2 percent, depending on the magnitude of the conductivity value. The results for all samples show a peak in the conductivity curves near 2 K for the purest material. The absolute value of the conductivity was, however, a function of the diameter and orientation of the particular sample measured, indicating the existence of a size effect. Dissert. Abstr.

N70-23562# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
CRYSTAL STRUCTURE OF SOLID SOLUTIONS OF THE SYSTEM ZnSe-CdSe [KRISTALLICHESKAYA STRUKTURA TVERDYKH RASTVOROV SISTEMY ZNSE-CDSE]
K. V. Shalimova et al Oct. 1969 10 p refs Transl. into ENGLISH from Kristallografiya (Moscow), v. 14, no. 4, 1969 p 629−633 Prepared for Lincoln Lab., MIT
(AZT-69-703-RULL) Avail: CFSTI

The crystal structure is investigated of solid solutions of ZnSe-CdSe, synthesized at 800-1200 C from original binary compounds. It is established that the lattice parameters of this solid solution are independent of the temperature of synthesis and obey Wegard's law. The position of the region of the phase transition in the investigated system is determined by the temperature of the synthesis. For the ZnSe-CdSe system, the molar concentration of its components can be determined from measuring the lattice parameters of the solid solution using simple relationships. Author

N70-23564# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
ELECTRON MICROSCOPE INVESTIGATIONS OF ZnS CRYSTALS [ELEKTRONENMIKROSKOPISCHE UNTERSUCHUNGEN VON ZNS-KRISTALLEN]
P. Golob et al Jan. 1970 20 p refs Transl. into ENGLISH from Z. Angew. Phys. (West Berlin), v. 25, no. 4, 1968 p 222−227 In ENGLISH and GERMAN Prepared for Lincoln Lab., MIT
(AZT-70-55-GELL) Avail: CFSTI

The surface of more than 40 ZnS and CdS single crystals grown from vapor phase and iodine transport reaction were investigated by electron microscope in the unetched state; different carbon, triafol or collodion replicafilm were used. Many hexagonal whiskers showed only small defect concentrations, whereas the laminar striated ZnS crystals with cubic and hexagonal zones show small as well as high defect concentrations which could be proved by X-ray diffraction. The observed striations of crystals can be caused by one dimensional defect or by growth which can be distinguished by etching the surfaces with activated oxygen in a high frequency gas discharge. By doping with Cd even in small concentration the hexagonal structure of ZnS crystal is stabilized. Then no more striations caused by one dimensional disorder can be detected. Author

N70-23566# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
PIEZORESISTANCE MEASUREMENTS ON ETA-SILICON [PIEZOWIDERSTANDSMESSUNGEN AN ETA-SILIZIUM]
M. Asche et al Sep. 1969 6 p refs Transl. into ENGLISH Phys. Status Solidi (Russian), v. 3, no. 8, 1963 p K255−K258 Prepared for Lincoln Lab., MIT
(AZT-69-590-GELL) Avail: CFSTI

The preparation of crystals, experimental methods and results of piezoresistance measurements on n-silicon are discussed. Author

N70-23589# Commissariat a l'Energie Atomique, Limeil (France).
SUPERCONDUCTING CURRENT GENERATORS [GENERATEURS SUPRACONDUCTEURS DE COURANT]
Pierre Genevey (Ph.D. Thesis—Paris Univ., 18 Mar. 1969) Jan. 1970 109 p refs In FRENCH; ENGLISH summary
(CEA-R-3783) Avail: CFSTI

Two current generators are described that create currents in the range 600 to 1400 A, for two storage experiments of 25 kJ and 50 kJ, respectively. The two current generators are a flux pump and a superconducting transformer, and both could be developed into more powerful units. The study shows the advantages of the transformer over the flux pump for creating large currents. The efficiencies of the two generators are 95 per cent and 40−60 per cent, respectively. Author (ESRO)

N70-23802# Aztec School of Languages, Inc., Maynard, Mass.
CURRENT CARRIERS IN FERROMAGNETIC SEMICONDUCTORS. THE CASE OF STRONG INTERACTION [NOSITELI TOKAV FERROMAGNITNYKH POLUPROVODNIKAKN. SLUCHAY SIL'NOGO VZAIMODEYSTVIYA]
M. A. Krivoglaz et al Jan. 1970 22 p refs Transl. into ENGLISH from Fiz. Tverd. Tela, (USSR), v. 11, no. 11, 1969 p 3119−3131 Prepared for Lincoln Lab., MIT
(AZT-70-146-RULL) Avail: CFSTI

Conduction electrons in crystals containing atoms with noncompensated spin are studied. The case in which spin-electron interaction is strong relative to spin-spin interaction and to kT, but

weak relative to the width of the conduction zone, is investigated. It is shown that under certain conditions electrons may be localized in the region of altered magnetization, leading to stabilization of the fluctuations in magnetization there and to the appearance of stable formations with large radii (magnetofluctuons). As a result there must be changes in the electron and magnetic properties of the crystal. The characteristics of the magnetofluctuons are investigated in ferromagnetics at low temperatures, in ideal paramagnetics and also in a molecular field approximation. Author

N70-23604# Aztec School of Languages, Inc., Maynard, Mass.
STUDY OF TRANSITIONS BETWEEN METALLIC AND INSULATING STATES. APPLICATION TO IMPURITY BANDS AND TO ANTIFERROMAGNETS [ETUDE DES TRANSITIONS ENTRE ETATS METALLIQUES ET ISOLANTS. APPLICATION AUX BANDES D'IMPURETE ET AUX ANTIFERROMAGNETIQUES]
J. des Cloizeaux Sep. 1969 39 p refs Transl. into ENGLISH from J. Physi. Radium, (Paris), v. 20, Aug. – Sep. 1959 p 751 – 763 Prepared for Lincoln Lab., MIT
(AZT-69-563-FRLL) Avail: CFSTI

Under definite assumptions, an electron gas in a solid may behave as an insulator, in contradiction to the predictions of the band theory. A simple model has been proposed previously. A more careful study gives the same results but shows that besides individual excitations there are two kinds of collective excitations: plasmons and spinons. An application of the model to disordered systems is discussed. Author

N70-23605# Aztec School of Languages, Inc., Maynard, Mass.
DETERMINATION OF THE LIFESPAN AND RECOMBINATION MECHANISM IN THE N-TYPE ALLOY CDD. 23 HGD. 77TE [DETERMINATION DE LA DUREE DE VIE ET DU MECANISME DE RECOMBINATION DANS L'ALLIAGE CD0 23HG0 77TE DE TYPE N]
Jean-Claude Ayache and Yves Marfaing Jan. 1970 10 p refs Transl. into ENGLISH from C. R. Acad. Sci. (Paris), v. 265, 1967 p 568 – 571 Prepared for Lincoln Lab., MIT
(AZT-70-57-FRLL) Avail: CFSTI

The following discussion concerns a determination of the lifespan and recombination mechanism in the n-type alloy CdHgTe using a gallium arsenide laser. Author

N70-23665# Aktiebolaget Atomenergi, Nykoping (Sweden).
AN EXPERIMENTAL STUDY OF THE ACCURACY OF COMPENSATION IN LITHIUM DRIFTED GERMANIUM DETECTORS
A. Lauber and B. Malmsten Oct. 1969 16 p refs Submitted for publication
(AE-373) Avail: CFSTI

The nature and magnitude of the space charge existing in the compensated layer of lithium drifted germanium detectors was studied as a function of drifted depth and of the electric field applied during drift. Experimental values were obtained from the dependence of detector capacitance on applied bias. In most cases there was a linear space charge gradient in the compensated layer. When small electric fields were applied to deep compensated layers, the space charge became constant throughout a large part of the compensated layer. There was some evidence for a strong decrease of mobile carrier recombination lifetime with increasing drifted depth, possibly down to a few microseconds for drifted depths of the order of 7 mm. The experimental results of the investigation were to a large extent in good agreement with theory. Author (ESRO)

N70-23685# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
APPLICATION OF MOESSBAUER EFFECT IN CRYSTALLOGRAPHY AND MINERALOGY Final Report
Stefan S. Hafner 14 Sep. 1969 11 p refs
(Grant NSF GA-1134)
Avail: CFSTI

Results of hyperfine spectra studies of Fe-57 in iron silicates are presented. The experiments show that Mg,Fe order-disorder in orthopyroxenes can be interpreted by employing simple thermodynamic concepts. Basic thermodynamical properties such as Mg,Fe exchange energies and activation energies for ordering and disordering can be approximately determined from site occupancy data and kinetics experiments at constant temperatures. Iron-bearing chain silicates may be magnetically ordered at low temperatures. From electric field gradient calculations of a large number of crystal structures, a realistic interpretation of the point multipole model and its convergence can be made. Realistic estimates of the variance of the electronic dipole, quadrupole, and octupole polarizabilities of the oxygen ion in predominantly ionic crystal structures are possible. Author

N70-23688# Aztec School of Languages, Inc., Acton, Mass.
THEORY OF THE INTERACTION OF ACOUSTICAL WAVES IN SEMICONDUCTORS [TEORIYA VZAIMODEYSTVIYA AKUSTICHESKIKH VOLN V POLUPROVODNIKAKH]
Levin et al Dec. 1969 20 p refs Transl. into ENGLISH from Zh. Eksperim. i. Teor. Fiz. (Russian), v. 56, no. 6, 1969 p 1881 – 1890 Prepared for Lincoln Lab., MIT
(AZT-69-687-RULL) Avail: CFSTI

From the equations of the elasticity theory, which take into account the space- and time-dispersion of elastic stress in an arbitrary cystallized medium, dynamic equations described the behavior of the amplitude of interacting waves in space and over time. These equations generalize the known Biombergen equations for a medium in which the transfer of energy from the waves to the medium is possible during nonlinear wave interaction. The equations of energy balance and the quantum number are discussed in the presence of both linear and nonlinear absorption. The nonlinear elastic responses of electron origin are found for piezosemiconductors with an arbitrary state of the electron subsystem. Author

N70-23690# Aztec School of Languages, Inc., Maynard, Mass.
THE ELECTRICAL RESISTANCE OF FERROMAGNETIC SEMICONDUCTORS NEAR THE CURIE TEMPERATURE [OB ELEKTROSOPROTIVLENII FERROMAGNITNYKH POLUPROVODNIKOV UBLIZI TEMPERATURY KYURI]
I. Ya. Korenblit et al Jan. 1970 6 p refs Transl. into ENGLISH from Fiz. Tverd. Tela. (USSR), v. 11, no. 10, 1969 p 3028 – 3030 Prepared for Lincoln Lab., MIT
(AZT-70-147-RULL) Avail: CFSTI

The electrical resistance of ferromagnetic semiconductors was discussed. The two cases of a degenerate and nondegenerate semiconductor were considered. Then the equations for the two cases were presented and compared. Author

N70-23694# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
PHOTOLUMINESCENCE OF UNALLOYED CRYSTALS OF GALLIUM ARSENIDE [FOTOLYUMINESTSENTSIYA NELEGIROVANN'KH KRISTALLOV ARSENIDA GALLIYA]
V. S. Bagayev et al Dec. 1969 6 p refs Transl. into ENGLISH from Fiz. Tverd. Tela (Leningrad), v. 11, no. 8, 1969 p 2268 – 2270 Prepared for Lincoln Lab., MIT
(AZT-70-71-RULL) Avail: CFSTI

The photoluminescence of unalloyed single crystals of GaAs is investigated. Ne – He lasers of the LG – 75 and LG – 36A types serve as sources of excitation. The spectra of GaAs photoluminescence at T = 77 and 8 K are presented as well as curves of the intensity function relating the observed emission band and the optical excitation level. A short discussion of the nature of the observed emission is given. Author

N70-23722# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

MAGNETO-OPTICAL PROPERTIES OF ORTHOFERRITES IN THE INFRARED BAND OF THE SPECTRUM [MAGNITOOPTICHESKIYE SVOYSTVA ORTOFERRITOV V INFRAKRASNOY OBLASTI SPEKTRA]

M. V. Chetkin et al Sep. 1969 8 p refs Transl. into ENGLISH from Fiz. Tverdogo Tela (USSR), v. 11, no. 6, 1969 p 1620–1623 Prepared for Lincoln Lab., MIT
(AZT-69-591-RULL) Avail: CFSTI

The magneto-optical properties of single crystals of orthoferrites YFeO sub 3 and YbFeO sub 3 were investigated in the wavelength range from 0.9 to 1.8 mu employing the method that is ordinarily used in studying the Faraday effect. It was shown that analysis of the obtained results may be made only by taking into account the double refraction of the crystals. The double refraction and the non-diagonal component of the tensor of the dielectric constant of YFeO sub 3 were determined. Author

N70-23748# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

ELECTRON SCATTERING ON NEUTRAL DONORS IN SEMICONDUCTORS [RASSEYANIYE ELEKTRONOV NA NEYTRAL'NYKH DONORAKH V POLUPROVODNIKAKH]

L. Ye. Blagosklonskaya et al Jan. 1970 10 p refs Transl. into ENGLISH from Fiz. Tverd. Tela (USSR), v. 11, no. 10, 1969 p 2967–2971 Prepared for Lincoln Lab., MIT
(AZT-70-145-RULL) Avail: CFSTI

A theoretical and experimental examination of electron scattering on neutral donors in semiconductors is presented. An expression is derived for the relaxation time on the assumption that electron scattering on neutral donors can be viewed as scattering on a hydrogen atom. It is shown that scattering is qualitatively different depending on whether the spins of the incident and atomic electrons are parallel or antiparallel. At low temperatures the relaxation time is a function of temperature. The relaxation time with scattering on neutral donors is determined in the experiments from the halfwidth of the line of cyclotron resonance. Measurements are made on Ge samples in the temperature range 1.9 to 5.5 K. The experimental findings are in agreement with the theory. Author

N70-23775# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

PROPERTIES OF METALLIC CONTACTS OF GOLD AND LEAD TELLURIDE [PROPRIETES DES CONTACTS METALLIQUES D'OR SUR LE TELLURURE DE PLOMB]

Rene Lancon Oct. 1969 6 p refs Transl. into ENGLISH from Comptes Rendus de l'Acad. des Sci., (Paris), v. 267, no. 11, 1968 p 559–562 Prepared for MIT
(AZT-69-665-FRLL) Avail: CFSTI

The electric properties of gold-lead telluride contacts may be explained by a simplified Schottky theory and show that the influence of surface states is negligible in this material. Author

N70-23817# European Space Research and Technology Center, Noordwijk (Netherlands).

AN ELECTRON MICROPROBE ANALYSIS OF CU SUB 2-X S LAYERS CHEMIPLATED ON SINGLE CRYSTALS AND THIN FILMS OF CdS

M. Fabbricotti, A. V. Aerschadt, J. J. Loferski, K. K. Reinhartz, A. P. v. Rosenstiel et al (Metaalinst. TNO, Delft, Neth.) Nov. 1968 19 p refs Presented at the 5th Intern. Congr. on X-ray Optics and Microanalysis, Tuebingen, Ger., 9–14 Sep. 1968
(ESRO-TN-37-ESTEC) Avail: CFSTI

The cupreous-sulphide barrier layer in cadmium-sulphide solar cells was investigated using an electron microprobe. In typical high-efficiency thin-film cells the cupreous sulphide was relatively homogeneous and its average thickness was approximately 1100 A. In low-efficiency cells the cupreous sulphide was very inhomogeneous. In model experiments with thick cupreous-sulphide layers on cadmium-sulphide single crystals, surface defects and crystallographic orientation had a strong effect on the cupreous-sulphide growth rate and pattern. Author (ESRO)

N70-23823# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

TRANSITION BETWEEN METALLIC AND INSULATING STATES FOR AN ELECTRON GAS. APPLICATION TO IMPURITY BANDS AND TO ANTIFERROMAGNETS, PART 1 [TRANSITION ENTRE ETATS METALLIQUES ET SOLANTS POUR UN GAZ D'ELECTRONS. APPLICATION AUX BANDES D'IMPURETES ET AUX ANTIFERROMAGNETIQUES, 1]

Jacques des Cloizeaux Sep. 1969 46 p refs Transl. into ENGLISH from J. Phys. Radium (Paris), v. 20 1959 p 606–620 Prepared for Lincoln Lab., MIT
(AZT-68-562-FRLL) Avail: CFSTI

In a solid, the Bloch approximation becomes invalid when the Coulombic repulsion between electrons is not small as compared to the bandwidth. Then, as it can be shown on a simple model, a transition from the metallic to the insulating state may occur. Such a result is obtained by means of a transformation which leads to a segregation of the electrons of opposite spins on two sublattices. The width of the forbidden band and the electron pseudo-levels are functions of temperature. Author

N70-23824# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

RELATIVISTIC GENERALIZATION OF THE MODIFIED APW METHOD [RELATIVISTISCHE VERALLGEMEINERUNG DES MODIFIZIERTEN APW-VERFAHRENS]

I. Hofmann et al Jan. 1970 11 p refs Transl. into ENGLISH from Z. Phys. (German), v. 229, 1969 p 123–130 Prepared for Lincoln Lab., MIT
(AZT-70-144-GELL) Avail: CFSTI

A relativistic generalization of the modified augmented-plane-wave method is presented. It is applied to the exact Dirac Hamiltonian as well as to approximated two-component Hamiltonians. The method produces spinors which are everywhere continuous with continuous derivatives, which is particularly important for the relativistic case. Author

N70-23845 National Lending Library for Science and Technology, Boston Spa (England).

GRAPHICAL REPRESENTATION OF THE SHEAR STRESS RATIOS IN FACE CENTRE CUBIC CRYSTALS

J. Diehl et al 1953 8 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 45, no. 3, 1954 p 489–492
(NLL-EE-TRANS-1910-(3774.5)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Shear stress in relation to orientation dependency on the work harding, glide direction, and esterism during tensile deformation in face centered cubic metal crystals is illustrated with the aid of graphical representations. Orientation dependency is considered in the case face centered cubic crystals with crystallographically equal, but macroscopically latent glide systems. Author

N70-23863*# Maryland Univ., College Park. Center for Theoretical Physics.

CRITICAL FIELD RATIO (H SUB c3)/(H SUB c2) FOR PURE SUPERCONDUCTORS OUTSIDE THE LANDAU-GINZBURG REGION. PART 2: T-Tc

Chia-ren Hu and Victor Korenman Feb. 1969 42 p refs
(Grant NSG-398; Contracts N00014-67-A-0239-003; DAHC04-67-C-0023; Grants AF-AFOSR-735-65; AF-AFOSR-68-1459-68)
(NASA-CR-109373; AD-684108; TR-911) Avail: CFSTI CSCL 20C

The appropriate generalization of Gor'Kov's linearized gap equation for a pure weak coupling, semiinfinite superconductor in a magnetic field, separated from vacuum or an insulator by a specularly reflecting surface, was found in a previous paper. In that paper we used the gap equation to study the surface nucleation critical field H sub C3 at T approximately 0 deg. K. Here we study the region I approximately T sub C and find the first three non-trivial terms in an expansion of the ratio H sub C3(T)/H sub C2(T) to be 1.695 (1 + 0.614 (1 −T) − 0.577 (1 −T) to the 3/2 power) where T is identically equal to T/T sub C. The term linear in has been found previously but the last term is new. For T close enough to T sub C we show that the system is accurately described by the linearized Landau-Ginzburg equation with the usual boundary condition and thus regain the results of Saint James and de Gennes. Author (TAB)

N70-23892# Illinois Univ., Urbana.
EFFECT OF POINT DEFECTS IN COPPER ON THE ANOMALOUS TRANSMISSION OF X-RAYS
Lewis Selig Edelheit Feb. 1970 78 p refs
(Contract AT(11-1)-1198)
(COO-1198-672) Avail: CFSTI

Anomalous X-ray transmission (Borrmann) measurements were made at 4.2 K on nearly perfect copper single crystals before and after irradiation at 20 K with 3-MeV electrons (total integrated flux 0.87 × 10 to the 18th power electrons sq cm). The intensity in the diffracted direction was measured for the (111), (222), (333), and (220) reflecting planes. The measured intensity changes were 1.15 + or − 0.4%, 4.52 + or − 0.06%, 8.90 + or − 0.8%, and 4.06 + or − 0.8%, respectively. A comparison of the observed intensity changes with theoretical predictions, assuming that the damage consists of isolated interstitials and vacancies, and using previously calculated displacements associated with these defects, indicates that the interstitial is not in the split (100) configuration. Possible configurations are the body-centered interstitial or the split (111) interstitial. Measurements after annealing at 80 and 300 K were made. The measurements indicated that defect clusters were formed when the irradiated crystal was heated to 80 K, and some clusters remained after annealing at room temperature. Author (NSA)

N70-23899*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
PROCESS MANUAL FOR PYROLITIC SILICON NITRIDE DEPOSITION
[1970] 17 p refs
(Contract NAS9-6636)
(NASA-CR-108332; HS-51431) Avail: CFSTI CSCL 20L

This manual was prepared for use as a guide in the pyrolytic deposition of silicon nitride (Si3N4) films on silicon substrates. The method employed for film formation is the pyrolytic decomposition of silane in an ammonia atmosphere at temperatures of 775 to 975 C. The manual contains both general and specific information with regard to materials, equipment, procedures, and process requirements for the above method of Si3N4 film deposition. Silicon nitride films prepared by the methods described, when deposited onto thin silicon dioxide films, have proven satisfactory for use as the gate dielectric of MOS transistors having a non-volatile memory storage effect. The films are used by others in the industry as diffusion masks and passivating layers for various devices. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N70-22787# Naval Research Lab., Washington, D.C.
EFFECT OF NAVY SPECIAL FUEL OIL ON THE CHARGING TENDENCY OF JET FUEL Interim Report
Joseph T. Leonard and Homer W. Carhart 20 Nov. 1969 19 p refs
(AD-698793; NRL-6953) Avail: CFSTI CSCL 21/4

As part of a long-range study on the generation and dissipation of static electricity in hydrocarbon liquids, the effect of Navy Special Fuel Oil contamination on the conductivity and charging tendency of JP-5 fuels was examined on a laboratory scale. It was found that while the conductivity of jet fuel increases with the addition of Navy Special Fuel Oil, the magnitude of this effect depends upon the nature of the impurities in both the JP-5 and the Navy Special Fuel Oil. The results of the present study indicated that if a load of jet fuel were to become contaminated with Navy Special Fuel Oil so that the conductivity of the resulting product were in the proper range, this fuel would emerge from a filter/separator unit in a much more highly charged condition than if it had not been contaminated. However, as long as sufficient time is permitted for the charge to relax before the fuel enters the receiving tank, no increase in electrostatic hazard should occur. Author (TAB)

N70-23046# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PETROLEUM PRODUCTS, PROPERTIES, QUALITY, APPLICATION, PART 1 APPLICATION, PART 2
B. V. Losikov 22 Aug. 1969 236 p refs Transl. into ENGLISH from the Russian Report
(AD-698440; FTD-HT-23-347-68-Pt-1) Avail: CFSTI CSCL 21/4

The handbook presents data concerning the properties, quality, and application of petroleum products: liquid fuels and oils, lubricants, paraffin, bitumen, special oils, solvents, etc. Each chapter includes tables and diagrams of a particular products properties, conditions for use, and efficiency. The first section contains chapter 1-3 which cover: Fuels for spark-ignition piston engines; Fuels for air-breathing reaction (jet) engines; and Diesel fuels. TAB

N70-23047# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PETROLEUM PRODUCTS, PROPERTIES, QUALITY APPLICATION, PART 1 APPLICATION, PART 2
B. V. Losikov 22 Aug. 1969 232 p refs Transl. into ENGLISH from the Russian Report
(AD-698546; FTD-HT-23-347-68-Pt-2) Avail: CFSTI CSCL 21/4

The document contains Chapters 4-6 of a Russian handbook of petroleum products. These chapters discuss fuel additives (antiknock, storage, corrosion), motor oils, and boiler fuels. TAB

N70-23199*# Union Carbide Plastics Co., Bound Brook, N.J.
SATURATED HYDROCARBON POLYMERIC BINDER FOR ADVANCED SOLID PROPELLANT Quarterly Report, 1 Apr. −30 Jun. 1969
James E. Potts, ed. 15 Jul. 1969 21 p refs Prepared for JPL
(Contracts NAS7-100; JPL-591210)
(NASA-CR-109358) Avail: CFSTI CSCL 21I

Ethylene/propylene/3-hydroxy-3-methyl butene terpolymers were prepared by high pressure free radical polymerization. Six samples were prepared having average hydroxyl functionalities over the range 1.2 to 2.0 and with molecular weights ranging from 1100 to 2000. A total of 26 lbs. of liquid terpolymer was prepared. The source of an initial foaming problem during isocyanate cures of these terpolymers was found to be water or some other substance removable by a drying operation. Dried terpolymer samples cure slowly with toluene diisocyanate without the formation of bubbles at 60 C. Author

N70-23223# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Raketentreibstoffe
EXPERIMENTAL INVESTIGATIONS ON THE HYPERGOLISING OF TETRAFLUOROHYDRAZINE

[EXPERIMENTELLE UNTERSUCHUNGEN DER HYPERGOLISIERUNG VON DISTICKSTOFFTETRAFLUORID]
Fritz Bachmaier Sep. 1969 21 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-60; DVL-885) Avail: CFSTI

Tetrafluorohydrazine was considered as a possible oxidizer for high energetic rocket fuels, because its performance and physical and chemical properties are very favorable. The only drawback is the missing hypergolitic property towards all fuels. Experiments for attaining hypergolic behavior towards hydrazine by adding dinitrogentetroxide or chlorinepentafluoride to tetrafluorohydrazine are reported. Dinitrogentetroxide reacts spontaneously with tetrafluorohydrazine, so it cannot be used as an additive. However, chlorinepentafluoride caused hypergolic ignition between tetrafluorohydrazine and hydrazine when added in small amounts of 2.5% by weight. Author

N70-23254# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strahlantriebe.
EXPERIMENTAL STUDIES ON COMBUSTION IN A LITHERGOL TEST MOTOR [EXPERIMENTELLE ARBEITEN UEBER DEN ABBRAND IN EINEM LITHERGOL-VERSUCHSTRIEBWERK]
Andreas Langemeyer May 1969 67 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-84) Avail: CFSTI

For the lithergol propellant combination LMU 2390 (a mixture of 90% diimidoxalicacidhydrazide and 10% polyurethane) with 98% HNO3 as oxidizer, thermodynamic calculations gave a specific impulse of 267.2 kp s/kg for a 70:1 expansion. Injection heads study and oxidizer load determination of the fuel surface are described, and the development of a test motor and motor installation are discussed. Two calculation methods were developed for fuel mass flow determination and the burning rate. Author (ESRO)

N70-23330# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMBUSTION OF FUELS WITH NONISOTOPIC HEAT CONDUCTIVITY
L. K. Gusachenko 4 Aug. 1969 10 p ref Transl. into ENGLISH from Kratkiye Soobshch. (USSR), p 310–312
(AD-698531; FTD-HT-23-362-69) Avail: CFSTI CSCL 21/2

A determination was made of the burning rate of solid fuels as it depends upon the direction in which the combination propagates and also determines the law of change of burning surface curvature. TAB

N70-23774# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Abteilung Bauneisen- und Konstruktionsforschung.
THE PRE-EVAPORATION OF LIQUID FUEL IN A SMALL RAMJET ENGINE [DIE VORVERDAMPFUNG VON FLUESSIGKRAFTSTOFF IN EINEM KLEINEN STAUSTRAHLTRIEBWERK]
Fritz Gehring (Ph.D. Thesis—Stuttgart Univ.) Sep. 1969 133 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-67) Avail: CFSTI

The application and functional reliability of this fuel preevaporation system in small tip drive ramjet engines is demonstrated. The influence of the operational parameters, such as velocity of air flow, altitude, air-fuel ratio, fuel flow rate, and pressure, on the caloric state of the fuel before injection and after expansion is the subject of a theoretical investigation. Author (ESRO)

N70-23789# Politecnico di Torino (Italy). 1st di Macchine e Motori per Aeromobili.
KNOCK CHARACTERISTICS OF SOME PARAFFIN HYDROCARBONS, RING PARAFFINS, AND AROMATICS FOUND IN AUTOMOBILE ENGINE FUELS [CARATTERISTICHE DI DETONAZIONE DI IDROCARBURI PARAFFINICI, CICLOPARAFFINICI ED AROMATICI CONTENUTI NEI CARBURANTI PER AUTOTRAZIONE]
Enrico Antonelli Dec. 1968 48 p refs In ITALIAN; ENGLISH summary *Its* Publ. No. 108
Avail: CFSTI

Using an instrument which counts the number and measures the amplitude of typical knock pressure fluctuations, knock intensity measurements were taken on a C.F.R. engine by varying the spark advance, the fuel air ratio, and the angular speed. The tests were carried out on one of seven main hydrocarbons (n-hexane, n-heptane, n-octane, isooctane, cyclohexane, benzene and toluene) and on a super gasoline. The results of the tests, plotted in graphs are analyzed to obtain a first indication in the choice of the hydrocarbons best suited to correct gasoline knock characteristics. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N70-22699*# General Electric Co., Cincinnati, Ohio.
STUDY PROGRAM FOR LIFT FAN NOISE REDUCTION AND SUPPRESSION
M. J. Benzakein and L. J. Volk Washington NASA Mar. 1970 116 p refs
(Contract NAS2-4763)
(NASA-CR-1493) Avail: CFSTI CSCL 21E

Noise reduction methods in terms of their effects on lift fan design were evaluated. Two lift fans were analytically modified to study acoustic reduction by tradeoffs in fan pressure ratio, tip speed, rotor-stator spacing, number of blades and vanes and the use of various types of acoustic materials. Author

N70-22871*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LIQUID PROPULSION
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 234–248 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 21H

A number of research programs have been conducted to evolve injector and thrust chamber design criteria applicable to the development of rocket engines for unmanned spacecraft, using the space storable propellant combination of oxygen difluoride and diborane. Thrust chamber design criteria evolved were based on the concept of a passively cooled chamber, combined with an injector having a controlled gradient mixture ratio. Author

N70-23278# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ORIENTATION OF THE DEVELOPMENT OF ION PROPULSION AND POSSIBLE APPLICATIONS [ORIENTATIONS RETENUES DANS LE DEVELOPPEMENT DE LA PROPULSION IONIQUE ET OBJECTIFS ACTUELS D'APPLICATIONS]
Emile Le Grives 1969 18 p refs In FRENCH; ENGLISH summary Presented at the 20th Intern. Congr. of Astronautics, Mar del Plata, Arg., 6-10 Oct. 1969 Submitted for publication
(ONERA-TP-764) Avail: CFSTI

The basic concepts of the electrostatic acceleration of particles are reviewed and the following various types of ion thrustors are described: (a) cesium contact ion thrustors, (b) electron

bombardment mercury and cesium ion thrustors, (3) heavy particle thrustors. Lifetime reliability, compatibility with solar panel systems, ability for micro-scaling and improvement of specific impulses as well as the reduction of feed voltages are also discussed. Various missions for which ion thrustors are well suited such as: station keeping and attitude control of geostationary satellites, application to free-drag satellites and transfer to synchronous orbits are briefly analyzed. Author (ESRO)

N70-23289*# Hughes Research Labs., Malibu, Calif.
LM CATHODE THRUSTER SYSTEM Quarterly Progress Report, 4 Oct. 1969 – 4 Jan. 1970
J. Hyman, Jr., J. R. Bayless, D. E. Schneiker, and J. W. Ward 15 Jan. 1970 43 p refs Prepared for JPL
(Contract NAS7-100; JPL-952131)
(NASA-CR-109353; QPR-2) Avail: CFSTI CSCL 21C

A 20 cm LM cathode thruster system is being developed for operation at beam currents I sub B = 0.5 A to 1.0 A and a beam voltage V sub B less than or approximately 2 kV. The thermal design and the thin-screen high transparency ion extraction system are similar to those of the 30 cm LM cathode thruster developed during the first phase of this contract. The discharge chamber configuration is derived from that of a 20 cm thruster with an externally cooled LM cathode, which was optimized during the first phase for operation at a beam current I sub B less than or approximately 800 mA. The new thruster, which employs a thermally integrated LM cathode, was assembled, and optimization testing was begun. A liquid mercury feed system is being assembled which consists of a high voltage isolator, an electromagnetic pump, a liquid mercury flowmeter, and a single capillary flow impedance. Prototype models of each of these elements demonstrated satisfactory operation under this contract. Thermal analysis confirms that the temperature of the thruster system remains within acceptable bounds for operation of an individual thruster, or for operation of an infinite planar cluster in which the separation between thruster centers is at least twice the thruster diameter. Author

N70-23337# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USING SUSPENDED MOISTURE FOR COOLING HIGH-TEMPERATURE GAS TURBINES
V. A. Barilovich et al 21 Aug. 1969 14 p refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Leningrad), No. 286, 1967 p 38–43
(AD-698437; FTD-MT-24-147-69) Avail: CFSTI CSCL 21/5

The study discusses cooling of high temperature turbines by introducing suspended water vapor. The cooling considered to date can be divided into four different methods. In methods I and II, the suspended water vapor is fed directly into the gas flow channel. In method I, water is injected directly into the gas flow. The water diffusion process can be mechanical or pneumatic. In method II, only a portion of the moistened cooling flow is injected into the dynamic section of the turbine. In method III, the suspended water vapor is used for cooling the blade radiator by employing a double flow cooling system. In Method IV, the blades are cooled by a single flow saturated with suspended water vapor. Recently, systematic experimental studies were conducted on cascade heat exchangers and cylindrical rods over a wide range of dimensions and gas dynamic characteristics of two-phase flows. Finned cascade heat exchangers were also investigated. The plotted data are shown. Author (TAB)

N70-23338# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPERATING CHARACTERISTICS OF GAS-TURBINE AIRCRAFT ENGINES
A. L. Klyachkin 23 May 1969 265 p refs Transl. into ENGLISH of the book "Ekspluatatsionnye Kharakteristiki Aviatsionnykh Gazoturbinnykh Dvigateley" Moscow, Izd. Transport, 1967 p 1–195
(AD-693551; FTD-MT-24-247-68) Avail: CFSTI CSCL 21/5

The operating characteristics of aviation gas turbine engines are reviewed. The information covers thermodynamic control principles, throttling, altitude, speed, acceleration, startup, and special characteristics of turbojet, turboprop, and turbofan engines. A number of important problems are covered, which until recently were not included in textbooks for civil aviation institutes. These problems include specific characteristics of double shaft by-pass turbojet engines with a high by-pass ratio; the effect of losses along the ducts and external factors on the engine performance and parameters; compressor instability, noise, and engine reliability. The book is based on non-Soviet information on jet engines published in aviation periodicals, and also on the experience gained by the Soviet aviation industry and the Ministry of Civil Aviation with the operation of aviation gas turbine engines designed by A. G. Ivchenko, N. D. Kuznetsov, and P. A. Solovyev. It is intended as a textbook for high scientific institutions of civil aviation, and it might be useful to persons engaged in aviation engine maintenance. TAB

N70-23346# Aeronautical Research Labs., Melbourne (Australia).
THE EFFECT OF OPERATING CONDITIONS ON AVON Mk 26 TURBINE BLADE CREEP LIFE
F. J. P. Wood Oct. 1969 11 p refs
(ARL/ME-309) Avail: CFSTI

The Avon Mk 26 engine in the Sabre aircraft is taken as an example to illustrate the effects of engine rpm and jet pipe temperature on turbine blade creep life. The requirement for statistical data on engine operating conditions, and their application to a life usage recording instrument, are discussed. Author

N70-23403*# Pratt and Whitney Aircraft, West Palm Beach, Fla.
SINGLE STAGE EXPERIMENTAL EVALUATION OF VARIABLE GEOMETRY INLET GUIDE VANES AND STATOR BLADING, PART 6 Final Report
B. A. Jones 15 Mar. 1970 123 p refs
(Contract NAS3-7604)
(NASA-CR-54559; PWA-FR-2641) Avail: CFSTI CSCL 21E

An analytical and experimental investigation was conducted to determine the extent that variable geometry inlet guide vanes and stators can extend the stable operating range of a supersonic-cruise turbine engine compressor front stage. The variable geometry guide vanes and stators, tested with uniform and distorted inlet flow in a 0.5 hub-tip ratio single-stage compressor, provided efficient, stable operation between the sea level takeoff (SLTO) design point and a Mach 3.0 cruise design point selected at 70% of the SLTO design corrected rotor speed and 54% of the design corrected flow. Author

N70-23475*# Rocketdyne, Canoga Park, Calif.
SPACE STORABLE ENGINE CHARACTERIZATION Final Report, Sep. 1968 – Mar. 1969
R. V. Burry Mar. 1970 98 p refs
(Contract NAS3-12024)
(NASA-CR-72559; R-7879) Avail: CFSTI CSCL 21H

A 5000-pound thrust FLOX/methane engine system for space applications was investigated. The engine is pump-fed with a milled channel, regeneratively cooled thrust chamber. A series of engine design candidates and design points were evaluated in terms of performance, complexity, operational flexibility and development ease. A description of these components is provided. An expander drive cycle using heated methane to provide power to two turbines operating in parallel was selected as the best engine configuration. A chamber pressure of 500 psia and a mixture ratio of 5.25 were selected as the best design point. A preliminary design investigation of the selected engine system, major components, and operational capability was conducted. Results of this investigation are described. The engine system has a weight of 89 pounds and is capable of

delivering a specific impulse value over 400 seconds within an envelope of 21.4 by 40.9 inches. Tank head start, throttling, idle mode, self-pressurization, and engine thrust uprating capability are provided by the engine. Author

N70-23525*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

STEADY STATE AIRFLOW AND AFTERBURNING PERFORMANCE CHARACTERISTICS OF FOUR J85 GE-13 TURBOJET ENGINES

Robert J. Antl and Richard R. Burley Washington Apr. 1970 25 p refs

(NASA-TM-X-1742; E-4690) Avail: CFSTI CSCL 21E

Tests to calibrate four J85-GE-13 afterburning turbojet engines in support of a flight test program were conducted in an altitude facility. Data were obtained over a simulated altitude range of 1500 to 55 000 feet and a simulated flight Mach number range of 0.2 to 1.7. Included are data on compressor airflow and interstage bleed characteristics, afterburner temperature rise and total pressure drop, and engine net thrust. The engines were calibrated with the manufacturer's variable-area convergent nozzle and with four, fixed-area, water-cooled convergent-divergent nozzles having an expansion ratio of 1.3. Comparisons are shown between the engines tested and with the engine manufacturer's predicted results. Author

N70-23577# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Energiewandlung und Elektrische Antriebe.

USE OF ELETROSTATIC PROPULSION AT LOWER EXHAUST VELOCITIES [VERWENDUNG ELEKTROSTATISCHER TRIEBWERKE BEI NIEDEREN AUSTRITTSGESCHWINDIGKEITEN]

K. R. Schreitmueller

Avail: CFSTI

Comparison of several spaceflight propulsion methods based on reliability, cost, propellant and the range of attainable exhaust velocities, shows great advantages for ion propulsion, particularly the colloidal and Hall types. Further improvements in the amount of electrical and mass action and also power density to a certain degree, seem to be possible. The performance level of ion propulsion compares well with the available energy sources in space. ESRO

N70-23653# Politecnico di Torino (Italy). 1st. di Macchine e Motori per Aeromobili.

A METHOD FOR EVALUATING THE OFF-DESIGN PERFORMANCE OF A RADIAL INFLOW TURBINE AND COMPARISON WITH EXPERIMENTS [PREVISIONE TEORICA DELLE PRESTAZIONI DI TURBINE RADIALI E VERIFICA SPERIMENTALE]

Andrea Dadone and Maurizio Pandolfi Aug. 1968 25 p refs In ITALIAN; ENGLISH summary *Its* Publ. No. 100

Avail: CFSTI

A method is outlined which is suitable to predict off-design performances of radial inflow turbines. Comparison is carried out with experimental results obtained on a small size radial turbine and with those reported in literature for a larger size radial turbine. A good agreement is found between theoretical predictions and experimental results. Author

N70-23673# Army Foreign Science and Technology Center, Washington, D.C.

MULTIFUEL ENGINES

L. A. Demyanov et al. 17 Nov. 1969 115 p refs Transl. into ENGLISH from the Russian Report

(AD-698788; FSTC-HT-23-304-70) Avail: CFSTI CSCL 21/7

By the term multifuel engines, the authors mean diesel engines which are capable of operating on various liquid oil fuels. Usually the range of fuels used for these engines is limited on the one hand to diesel fuels and on the other to motor vehicle and aviation gasoline with an octane up to 100. The following topics are discussed by the authors: Fundamentals of Mixture Formation and Combustion Theory in Diesel Engines; The Effect of Various Fuels on the Operation of Diesel Engines and Multifuel Engines; Design Peculiarities of Some Foreign and Domestic Diesel Engines Operating on Various Fuels; and Reliability and Life of Engines Operating on Various Fuels and Their Operating Characteristics. Author (TAB)

N70-23700# Messerschmitt-Boelkow G.m.b.H., Munich (West Germany). Unternehmensbereich Raumfahrt.

CONSTRUCTION CRITERIA OF ELECTRIC PROPULSION SYSTEMS FOR THE GEOSTATIONARY ORBIT [AUSLEGUNGSKRITERIEN ELEKTRISCHER ANTRIEBSSYSTEME FUER DEN GEOSTATIONAEREN ORBIT]

H. Schweig 1969 35 p In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969

(RF-113-0) Avail: CFSTI

Application satellites, such as those for television live-transmissions, are currently of interest but the electrical power required for this purpose leads to satellite masses beyond the capacity of present-day and planned European launcher rockets. A solution is proposed in which electric propulsion systems are used for transfers from a low orbit to a geostationary one. Two possibilities, mainly solar and nuclear electric power generation, were examined for their transfer capabilities and their role in optimization of the payload-electric power ratio, for a television satellite. Different systems were derived from that analysis and they are discussed and compared. ESRO

N70-23842# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strahlantriebe.

DESIGN AND TESTING OF A MERCURY-FEED SYSTEM FOR AN ELECTROSTATIC ION PROPULSION SYSTEM WITH AN AUTOCATHODE [AUFBAU UND UNTERSUCHUNG EINES HG-FOERDERSYSTEMS FUER EIN ELEKTROSTATISCHES IONENTRIEBWERK MIT AUTOKATHODE]

Harro Bessling Aug. 1969 22 p refs In GERMAN; ENGLISH summary

(DLR-MITT-69-17) Avail: CFSTI

A mercury-feed system for a Kaufman thrustor with a liquid mercury cathode is described. In this system the mercury is forced through a porous tungsten plug by means of compressed air. The feed rate is controlled by varying the air pressure and the temperature of the porous tungsten. The relationship between the mercury flow rate and the air pressure found experimentally is shown in a diagram. The flow mechanism inside the porous tungsten deviates from Poiseuille law in accordance with the experimental results. Author (ESRO)

N70-23858# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strahlantriebe.

THE IMPORTANCE OF ELECTRIC PROPULSION FOR THE TRANSPORT OF PAYLOADS INTO TWENTY-FOUR HOUR ORBITS [DIE BEDEUTUNG ELEKTRISCHER TRIEBWERKE FUER DEN NUTZLASTTRANSPORT IN DIE 24-H-BAHN]

W. Oldekop DGLR 1969 25 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969

Avail: CFSTI

German developments in the field of electric propulsion and power generation are examined, with regard to their suitability for installation on board high-power payload satellites in geostationary twenty-four hour orbits. The study is limited to ion propulsion and

solar and nuclear power generation. Possible applications of these systems with the Europa 1 and the hypothetical Europa 3 rockets for broadcasting purposes are discussed. ESRO

N70-23903*# Wyle Labs., Inc., Huntsville, Ala. Payne Div.
AN APPLICATION OF THEORY TO AXIAL COMPRESSOR NOISE
J. B. Ollerhead and C. L. Munch Washington NASA Apr. 1970 103 p refs
(Contract NAS1-8278)
(NASA-CR-1519; WR-69-15) Avail: CFSTI CSCL 21E

The theoretical solutions for the discrete frequency noise radiation by compressors and fans are reviewed and programmed for computer solution. A method is developed to predict both steady and unsteady compressor airloads which generate the noise and which are required as input to the acoustic theory. Comparisons of theory and experiment show encouraging agreement, at least for the first harmonic noise and the potential of the method for design applications is demonstrated. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N70-22648# Oak Ridge National Lab., Tenn.
RADIATION EFFECTS ON EARTH SATELLITES AND SOLAR PROBES DURING SOLAR FLARES
K. Wohlleben [1969] 20 p refs Transl. into ENGLISH from Raumfahrtforschung (Germany), v. 13, 1969 p 54–61
(ORNL-TR-2248) Avail: CFSTI

The radiation effects caused by solar flare protons are examined for earth satellites and solar probes. The calculations are based on the annual flux of solar protons near to the Earth's orbit (1 au) estimated from empirical relationships with the sunspot number for sunspot cycle 20 (1965–1975), account being taken of the propagation of solar protons in interplanetary space and the shielding effect of the Earth's magnetic field. For the planned solar probe (perihelion 0.3 au, aphelion 1.0 au) a cumulative radiation effect 2.8 times greater than in 1 au is anticipated. With an equatorial synchronous satellite and a shielding thickness <0.5 g/sq cm–as well as with the AZUR satellite—the cumulative radiation effects (defects/cu cm a, Rad/a, solar cell damage/a) are always smaller than the effects produced by Van Allen radiations (AZUR) or greater than the latter (synchronous satellite with shielding >0.5 g/sq cm). Author (NSA)

N70-22875*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ACCELERATION OF PROTONS BY INTERPLANETARY SHOCKS
K. W. Ogilvie and J. F. Arens Mar. 1970 23 p refs Submitted for publication
(NASA-TM-X-63850; X-692-70-42) Avail: CFSTI CSCL 03B

Observations of charged particles at the time of passage of interplanetary shocks past the satellite Explorer 34 are discussed. The short duration increases in flux seen at 1 Mev are interpreted as particle acceleration, and are found to be consistent in duration and magnitude with the idea of energy gain by successive reflection between the earth's bow shock and the incoming propagating shock. The corresponding correlation length of the interplanetary field is deduced to be approximately 0.005 AU. From the small sample observed it appears that shocks occurring when the interplanetary magnetic field at the observers position does not intersect the bow shock do not show particle flux increases, and that particles from the solar wind are not accelerated to 1 MeV by any of the observed shocks. Author

N70-22889*# Space Disturbances Lab., Boulder, Colo.
SOLAR PROTON MONITORING SYSTEM
G. W. Adams and L. R. Megill Aug. 1969 47 p refs
(NASA Order T-15237(G))
(NASA-CR-109319; ESSA-TR-ERL-119-SDL-10) Avail: SOD $0.50; CFSTI CSCL 03B

A real-time solar-proton monitoring system with ground-based sensors located in Alaska and other parts of the United States, Greenland, and Canada is discussed. A computer in Anchorage, Alaska, interrogates the sensors, processes the data, and transmits the information via teletype to the Solar Forecast Center in Boulder, Colorado. The physics of the system is described, i.e., the characteristics of the events (PCA's, auroras, SID's, REP's, and solar noise bursts), how the sensors (riometers, VLF phase and amplitude, forward scatter, neutron monitors, and magnetometers) respond to these events, how these characteristics are programmed to detect the different events, and how the sensor readings are used to obtain information about solar protons. Author

N70-23119# Denver Univ., Colo.
LONG RANGE SOLAR FLARE PREDICTION
J. B. Blizard *In* AGARD Ionospheric Forecasting Jan. 1970 10 p refs (See N70-23112 10-07)
Avail: CFSTI

Prediction of solar proton events is essential for the space program. Traditional methods have not solved the problem. Therefore an unconventional approach was taken. A high correlation was found between planetary conjunctions and proton events during 1956-1961. Although a correlation can be demonstrated with individual conjunctions, proton events usually occur after sequences of conjunctions of the planets Mercury, Venus, Earth and Jupiter. A trial prediction method has been attempted since 1965 indicating the dates of the 14-day passage of proton active centers. During the last 3 years the sensitivity was 63% and the reliability was 70%, despite the fact that proton events were predicted during only 22% of the total time, using only 5 parameters. Although the theoretical interpretation is not clear at this time, it does not detract from the predictive value of such a method. Proton events have been shown to be related to the positions of four planets which possibly affect the tidal force on the sun or other solar system dynamic variables. Author

N70-23120# Environmental Science Services Administration, Boulder, Colo. Environmental Research Labs.
TECHNIQUES OF SOLAR FLARE FORECASTING
Patrick S. Mc Intosh *In* AGARD Ionospheric Forecasting Jan. 1970 7 p refs (See N70-23112 10-07)
Avail: CFSTI

Approaches to solar flare forecasting are reviewed and the present forecasting "state of the art" is discussed. The most recent forecasts have shown marked improvement in accuracy and effectiveness in giving warning at least one day in advance of increasing solar activity. Further improvement in forecast performance will depend on: (1) changes in the kind of data reported by the routine solar patrol observatories; (2) an increase in the number of professionally trained forecasters; and (3) the utilization of recent advances in data processing instrumentation. Author

N70-23122# Air Force Cambridge Research Labs., Bedford, Mass.
MULTIFREQUENCY SOLAR RADIO BURSTS AS PREDICTORS FOR PROTON EVENTS
R. M. Straka and W. R. Barron *In* AGARD Ionospheric Forecasting Jan. 1970 12 p refs (See N70-23112 10-07)
Avail: CFSTI

Success in the use of radio spectral signatures for predicting a PCA event after the occurrence of a solar flare is evaluated.

Selected 1966-1968 radio bursts, both proton and nonproton associated, were integrated in flux to obtain the spectral energy characteristics of each event. Large energies in the meter wavelength range were particularly noted with large PCA events. Burst mean flux times duration as a substitute for actual energy values obtained by integration are examined. Energy spectral characteristics are shown as a function of flare longitudinal position. Total radio energies obtained by integration of the energy spectrum in the 500 - 8500 MHz range are obtained and compared in terms of the East-West longitudinal flare position to magnitudes of the associated PCA events. Author

N70-23123# Air Force Cambridge Research Labs., Bedford, Mass.
RADIO BURST SPECTRA AND THE SHORT TERM PREDICTION OF SOLAR PROTON EVENTS
John P. Castelli and Jules Aarons *In* AGARD Ionospheric Forecasting Jan. 1970 10 p refs (See N70-23112 10-07)
Avail: CFSTI

A short range prediction scheme designed to forecast solar proton events has been described in earlier papers. It depends on highly accurate measurements of solar burst flux densities at a wide range of frequencies. The success of the technique is examined with data from 1966, 1967 and 1968. The "miss" rate for principal PCA's based on the criteria is close to zero if we discount events apparently associated with far side of the sun flare-bursts. While some radio bursts meeting these criteria are "false alarms", the rate is considerably lower than with any other short term prediction method. Author

N70-23200*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW RIGIDITY COSMIC RAYS IN THE INTERSTELLAR MEDIUM
V. K. Balasubrahmanyan and E. A. Boldt Mar. 1970 9 p refs
(NASA-TM-X-63862; X-661-70-94) Avail: CFSTI CSCL 04A

Measurements of the galactic radio background at approximately 1 MHz imply that the intensity of low rigidity (approximately 0.3 GV) electrons beyond the solar system is much greater than that directly observed near the earth. Taking this depression of intensity as arising mainly from a solar modulation applicable to all cosmic rays of comparable rigidity, it is shown that the flux of subrelativistic protons and alpha particles in the galaxy would be sufficient for heating the interstellar HI gas and providing the ionization needed for maintaining the large electron content indicated by pulsar dispersion measures. A nonuniform spatial distribution of galactic cosmic rays would be a consistent feature of this description. Author

N70-23208*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NONTHERMAL HEATING IN THE TWO-FLUID SOLAR-WIND MODEL
R. E. Hartle and Aaron Barnes (NASA, Ames Research Center) Apr. 1970 47 p refs
(NASA-TM-X-63864; X-621-70-114) Avail: CFSTI CSCL 03B

The two fluid solar-wind model predicted values for wind speed and proton temperature that are lower than average observed values; however, the predictions are consistent with the empirical relation of Burlaga and Ogilvie in which the square root of the proton temperature is proportional to the wind speed. Since observed values of wind speed and proton temperature are typically higher than those of the two fluid model, it is concluded that energy must be supplied by dissipation of nonthermal energy from an external source. The two-fluid model is therefore extended by including ad hoc an energy source in the proton heat equation whose strength and spatial distribution is varied to determine the general requirements of such a source. Author

N70-23364# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC DATA. PART 2: SOLAR AND GEOPHYSICAL DATA
Nov. 1969 10 p
(RRC-173-Pt-2) Avail: CFSTI

Solar observational data are reported for October 1969. Included are tables for predicted sunspots and observed sunspots, solar flux, solar flares, and magnetic storms. F.O.S.

N70-23387# Leiden Univ. (Netherlands).
THE OSCILLATORY MOTION OF THE MAGNETOPAUSE AND THE EARTH'S BOW SHOCK
Gjalt Roelof Smit (Ph.D. Thesis) 1969 53 p refs Sponsored by ESRO
Avail: CFSTI

Satellite observations have shown that the magnetopause and the bow shock in front of it are in an oscillatory motion. The interaction between the solar wind and the geomagnetic field is summarized, and the observations concerning the motion of the two surfaces are discussed. They are separated into two classes: a fast motion with a period of 6 to 10 minutes and an amplitude of 0.1 to 2R sub E, and a slow motion with a period of 20 to 100 minutes and an amplitude of 0.5 to 3 R sub E. A model is introduced that replaces the fast motion of the magnetopause by a resonance vibration driven by fluctuations in the solar wind. The fast motion of the bow shock is treated by observing the motion as a curved shock wave standing against an oscillating axisymmetric body (the magnetopause) that is placed in a time-dependent gas-dynamic flow. The slow motion of the two surfaces is explained as an adiabatic compression and expansion as a result of slow changes in the characteristics of the solar wind. ESRO

N70-23528*# American Nucleonics Corp., Glendale, Calif.
A STUDY OF THE EFFECT OF THE ELECTROMAGNETIC INTERACTION BETWEEN THE MOON AND THE SOLAR WIND
K. Schwartz Dec. 1969 102 p refs
(Contract NAS2-5153)
(NASA-CR-73433; ANC-53R-12) Avail: CFSTI CSCL 03B

The electromagnetic interaction of the solar wind with the moon was investigated. These investigations cover the DC and time dependent interactions which were initiated to provide a theoretical framework by which the experimental data obtained from the Explorer 35 magnetometer and the Apollo 12 ALSEP magnetometer can be interpreted and correlated. The DC interaction has also been proposed as a possible mechanism for providing an intense heating phase during the initial development of the solar system. An alternative model for the T Tauri environment is proposed. This alternative model tends to have higher driving fields, and higher momentum and energy flux during the period when intense planetary heating can occur. Author

N70-23622*# Palomar Observatory, Pasadena, Calif.
TWO PROMINENCE ERUPTIONS AND THE PROBLEM OF EMISSION
Harold Zirin Oct. 1968 24 p refs
(Grant NGR-05-002-034; Contract N00014-67-C-0140; Grant NSF G-1472)
(AD-678442; NASA-CR-109377; TR-2) Avail: CFSTI CSCL 03B

Two flare unconnected eruptions on January 15 and 29, 1968 are discussed. The first is a filament which turns bright and erupts upward, reappearing an hour later. The second is a large eruptive arch seen against the disk. The arch is bright at the top of its trajectory, turns dark, but produces chromospheric emission at the point of impact. The emission at the top of the arch is ascribed to the velocity shift of the illuminating chromospheric H-alpha line. It is shown that such emission will occur only if the motion is transverse to the line of sight and the prominence is optically thin. Author

N70-23719*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
INITIAL OBSERVATIONS OF GEOMAGNETICALLY TRAPPED PROTONS AND ALPHA PARTICLES WITH OGO-4

T. A. Fritz and S. M. Krimigis Dec. 1968 61 p refs
(Contract NAS5-3097; NASA Order R-21-009-004(13); Contracts Nonr-1509(06); NOw-62-0604-c)
(AD-681006; NASA-CR-109374; Rept-68-65) Avail: CFSTI CSCL 04A

The detector package on board the OGO-4 satellite, includes two totally depleted solid state detectors with thickness of 34 and 7.2 microns designed to measure protons and alpha particles, respectively. Results show the following: (1) The j sub alpha/j sub p ratio is approximately 7 × 0.0001 and 2 × 0.0001 for particles of Epsilon > 0.35 and 0.46 MeV/nucleon, respectively; (2) The observed ratio ranges from 2 × 0.0001 for Epsilon > 0.46 MeV/nucleon, to 2.4 × 0.001 for Epsilon > or = to 0.68 MeV/charge, to 1.9 × 0.01 for total Epsilon > or = to 1.06 MeV when the proton and alpha particle intensities are compared; (3) there are indications that the ratio j sub alpha/j sub p decreases as the energy/nucleon increases; (4) the proton energy spectrum is well represented by a simple exponential spectrum in which the spectral parameter varies; and (5) comparison of the data with various predictions of models that consider the solar wind as source of trapped particles shows that there are serious discrepancies between theory and observations. Author

N70-23776# Academy of Sciences (USSR), Moscow.
COSMIC DATA Monthly Review, Feb. 1969
1969 39 p *In* RUSSIAN; ENGLISH summary *Its* No. 2
Avail: CFSTI

The results of observations on geophysical phenomena concerning electric and magnetic state of the upper atmosphere (geomagnetic variations, isonosphere; cosmic rays and earth current) and also the data of solar activity are published. This issue contains the data for February 1969. The explanation to the tables are given in the Review No. I for January 1969. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N70-22511# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
NUMERICAL VERIFICATION OF EXPRESSION FOR ZONAL HARMONIC ORBITAL PERTURBATIONS
Robert E. Jenkins and Anthony G. Lubowe Aug. 1969 42 p refs Prepared in cooperation with Bell Telephone Labs.
(Contract NOw-62-0604-C)
(AD-697904; APL-TG-1078) Avail: CFSTI CSCL 22/3

Expressions are given for the first order node-to-node perturbations in the orbital elements of a satellite arising from an arbitrary zonal harmonic of the geopotential. Comparison with a double precision numerical integration is made for an intermediate altitude satellite, TELSTAR I. (Second order perturbations due to the second harmonic, derived elsewhere, are included, as well as the first order perturbations due to the zonals through the fourteenth order). Discrepancies in semimajor axis after one period are of the order of 0.1 mm. Discrepancies in timing are of the order of 0.03 ms. Author (TAB)

N70-22512# Denver Univ., Colo. Dept. of Physics.
INFRARED ATOMIC TRANSITIONS PROBABILITIES
Ahron Goldman Sep. 1969 109 p refs *Its* No. Scientific-5
(Contract F19628-68-C-0233; ARPA Order 363)
(AD-698811; AFCRL-69-0447) Avail: CFSTI CSCL 3/2

The report presents results from one phase of the problem of atomic solar lines in the infrared. It contains machine prepared tables of electric dipole transitions probabilities for many atomic spectral lines in the region 0.8 - 2.5 microns. The elements covered are Al(I), C(I), Ca(I), Ca(II), Fe(I), K(I), Mg(I), Mg(II), Na(I), Si(I), and Si(II). These calculations have been made by assuming LS coupling and by using the Coulomb approximation for the radial matrix elements according to Bates and Damgaard. Line positions and effective quantum numbers have been calculated from empirical values for energy levels. These are given by the NBS publications on atomic energy levels. Author (TAB)

N70-22536# RAND Corp., Santa Monica, Calif.
RADIATIVE TRANSFER IN SPHERICAL SHELL ATMOSPHERES WITH RADIAL SYMMETRY
S. Ueno, H. Kagiwada, and R. Kalaba Oct. 1969 37 p refs
(Contract F44620-67-C-0045)
(AD-698321; RM-6061-PR) Avail: CFSTI CSCL 3/2

Initial-value systems are obtained for the scattering and transmission functions and emergent intensities for inhomogeneous, anisotropically scattering spherical media. Integro-differential equations are derived from transfer equations for each of the following problems: (1) an externally illuminated spherical shell atmosphere with a reflecting inner surface, (2) a spherical shell atmosphere surrounding a perfect black core, (3) a spherical shell atmosphere surrounding a vacuum core with a central point source, and (4) a spherical shell atmosphere with internal sources of radiation. The equations obtained in this study are new and exact. Some are derived with the aid of the probabilistic method. These equations can be integrated easily in numerical computation. Author (TAB)

N70-22572*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC POTENTIAL MODEL FOR THE STRUCTURE OF THE SOLAR CORONA FOR THE MARCH 1970 ECLIPSE
K. H. Schatten Mar. 1970 29 p refs
(NASA-TM-X-63856; Rept-X-692-70-89) Avail: CFSTI CSCL 03B

Features of the solar corona observable at the time of a solar eclipse are discussed and compared with ground based measurements of the corona using a standard coronagraph. A model for determining the large scale structure of the coronal and interplanetary magnetic fields is presented. The effects of solar activity upon the model and the observed corona are shown. The application of the model to observable features of the solar corona at the time of solar eclipses is discussed. In particular the recent Siberian solar eclipse is compared with predictions from the model. The features expected from the model for the March 1970 solar eclipse are shown. Author

N70-22863 Virginia Univ., Charlottesville.
STUDIES OF COOL STARS IN THE ONE MICRON REGION
George Wesley Lockwood (Ph.D. Thesis) 1968 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-3992

Infrared image-tube spectra of a number of late-type stars have been obtained with a cassegrain spectrograph and 32-inch reflecting telescope. The wavelength interval of 7900 to 12000 A was surveyed at a reciprocal linear dispersion of 45 A/mm. The initial goals of the survey were (1) to study differences in infrared stellar spectra as a function of spectral class, and the changes in the spectra of long-period variables with phase, and (2) to search for indicators of stellar water vapor in the 1.1 micron region. Eleven spectrograms of K and M giants, and the Mira variable, R Leo, were reduced by conventional methods. Wavelengths were determined with an accuracy of about 1 A. Sixteen band heads of TiO were observed in the spectrum of R Leo from 8205 to 11032 A. Several absorption lines, identified with weak telluric H2O lines at 11053, 11060-64, and 11078 A appear stronger in the spectra of the variables R Hya and R Leo (M7e) than in the comparison star alpha Boo observed on the same nights. It is proposed that

the variable absorption lines are due to high-temperature lines of the 1,1,1 band of H2O in the cooler stars, and it is shown that high-temperature lines should appear in this region. Dissert. Abstr.

N70-22727*# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADAR STUDIES OF THE MOON AND MARS Quarterly Progress Report
15 Oct. 1969 32 p refs
(Contract NAS9-7830)
(NASA-CR-108305; QPR-6) Avail: CFSTI CSCL 03B

Significant findings resulting from the data analyses of radar observations are discussed. Lunar studies include: (1) backscatter mapping, (2) profile measurements of lunar topography, (3) scattering law measurements, and (4) qualitative surface morphology. The Mars material includes tables of delay ranging measurements and a section dealing with the determination of Mars topography. D.L.G.

N70-22728*# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADAR STUDIES OF THE MOON AND MARS Quarterly Progress Report
15 Jul. 1969 25 p
(Contract NAS9-7830)
(NASA-CR-108304; QPR-5) Avail: CFSTI CSCL 03B

Preliminary results of radar observations are discussed. The Lunar studies include reports on observations and the reduction of data, ephemeris discrepancies, and topics for analysis. The Mars material includes measurement and reduction techniques, observations and results, and the interpretation of these results. D.L.G.

N70-22742* Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADAR STUDIES OF MARS Final Report
18 Feb. 1970 85 p refs
(Contract NAS9-7830)
(NASA-CR-108312) Avail: CFSTI CSCL 03B

The analysis of the radar measurements of Mars shed more light on the nature of the Martian surface. By correlating the radar results with optical observations, it is clear that the optically dark areas have a significantly higher intrinsic radar reflectivity and are somewhat smoother on the scale of the 3.8-cm radar wavelength than other regions. Also, there is a tendency for optically dark areas to lie on the eastern slopes of the radar measured topographic highlands at least in the radar probed strip extending from the equator to 22 deg N. These results are consistent with a model of dark areas being bare rock producing a high radar reflectivity and other areas being dust covered surfaces of low radar reflectivity. The tendency of bare rock areas to be on the eastern slopes of Martian highlands may be due to a prevailing wind pattern on Mars. Conclusions important for the landing of a spacecraft on Mars are: (1) Mean small scale surface slopes are sufficiently small that there is a high probability that a spacecraft would rest on the surface oriented to within a few degrees of the zenith. (2) Martian highlands have an atmospheric pressure of about 3 millibars compared with about 9 millibars for the lowlands. Author

N70-22755*# Princeton Univ. Observatory, N.J.
OBSERVATIONS OF INTERSTELLAR LYMAN-alpha ABSORPTION
Edward B. Jenkins 18 Aug. 1969 31 p refs Presented at IAU Symp. No. 36 on Ultraviolet Stellar Spectra and Related Ground-Based Observations
(Contract NSR-31-001-901)
(NASA-CR-109282) Avail: CFSTI CSCL 03B

Absorption at the Lyman-alpha transition from interstellar neutral hydrogen is observed in the ultraviolet spectra of 18 nearby O and B stars. Radiation damping is the dominant cause of line broadening, making the derived line-of-sight column densities proportional to the square of the observed equivalent widths. An average hydrogen density on the order of 0.1 atom 1/cu cm is found for most of the stars observed so far. This is in contrast to the findings from surveys of 21 cm radio emission, which suggest 0.7 atom 1/cu cm exists in the local region of the Galaxy. Several effects which might introduce uncertainties into the Lyman-alpha measurements are considered, but none seem to be able to produce enough error to explain the disagreement with the 21 cm data. The possibility that small scale irregularities in the interstellar gas could give significantly lower values at Lyman-alpha is explored. However, a quantitative treatment of the factor of ten discrepancy in Orion indicates the only reasonable explanation requires the 21 cm flux to come primarily from small, dense, hot clouds which are well separated from each other. The existence of such clouds, however, poses serious theoretical difficulties. Author

N70-22785 California Univ., Berkeley.
FORMATION AND EQUILIBRIUM OF INTERSTELLAR CLOUDS
Donald William Goldsmith (Ph.D. Thesis) 1969 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-18925

The physical conditions study of the interstellar medium is based on calculations of the heating by low-energy cosmic rays and leads to an equilibrium mode in which two thermally stable gas phases coexist in pressure equilibrium. The hot gas, which is about 10% ionized, occupies most of interstellar space. Gravitation in the z-direction compresses about 75% of the material present into the cool, dense phase to form clouds. With the proper choice of three parameters, seven observational results are predicted to within a factor of two. These observational parameters are: (1) the clouds' filling-factor in interstellar space; (2) the z-dispersion of the intercloud medium; (3) the 21-cm emission and absorption temperatures; (4) the diffuse background component seen in 21-cm emission at intermediate latitudes; (5) the underabundance of sodium in clouds; (6) the free-free absorption of long radio waves; and (7) the number density of electrons in the intercloud medium as determined by pulsar dispersion measurements. Dissert. Abstr.

N70-22855*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY SCIENCES
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 20–22 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 03B

The feasibility of using the downlink beacon on the Viking Orbiter for surface and subsurface water detection is evaluated for its application in choosing a landing site on Mars and for studying the spatial-temporal distribution of surface and subsurface water at the landing area. Integration of the returned signal pulses over all Doppler frequencies will make it independent of surface roughness; resolution may be improved by passing the return through a series of bandpass filters, but the output of each filter will depend on rms slope as well as reflection coefficient. G.G.

N70-22872*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEMS ANALYSIS
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 249–265 (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 22C

Analyzed are following mission aspects: (1) trajectory considerations for an Earth to Jupiter to Saturn to Pluto mission and the principle factors for its design; (2) optimum ballistics for a solar low thrust electric propulsion Saturn Orbiter mission to Saturn (3) queuing problem approach to determine the optimal number of remote computer terminals necessary to serve computer needs for an organization; and (4) elimination of starting values in exponential smoothing method. G.G.

N70-22902*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPERIMENTS AND MISSION DESCRIPTION
In its Conceptual Design of a High Energy Astronomy Obs. 18

Feb. 1970 14 p (See N70-22901 10-31)
Avail: CFSTI CSCL 22A

A representiative group of experiments was selected to establish overall mission operational requirements, develop conceptual spacecraft designs, and to determine subsystem and system design requirements for the HEAO satellite. The primary objective of the selected baseline experiment package is to scan the entire celestial sphere for X-rays, gamma rays, and cosmic rays, with emphasis on the galactic belt. The secondary objective of the mission is pointing at selected source targets for more detailed analysis in a preferred sequence of galactic scan, celestial scan, and pointing mode. The baseline mission profile is described and the sequence and approximate time intervals for each mission phase are shown. R.B.

N70-22904*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ORBIT SELECTION AND OPERATIONS
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 54 p ref (See N70-22901 10-31)
Avail: CFSTI CSCL 22C

The primary considerations in choosing the orbit of the HEAO-A satellite include the requirement of a lifetime of one year so that a maximum payload may be placed in orbit and possible interference by the South Atlantic Anomaly on the scientific instruments is minimized. Since lifetime is primarily a function of aerodynamic drag and drag depends upon atmospheric density and satellite characteristics, two main problems are considered in computing future values of density based on understanding of the mechanisms by which density is increased with an increase of solar radiation and on predicting future levels of solar activity. The sequence of orbital operations are outlined for the scheduled lifetime of the satellite. R.B.

N70-22916*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOUTH ATLANTIC ANOMALY AND ORBIT OCCULTATION, APPENDIX C
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 32 p refs (See N70-22901 10-31)
Avail: CFSTI CSCL 22C

The electron flux counting rate over the South Atlantic anomaly is given for a one-year period of observation. The measured anomaly region is relatively constant in size and shape with time. The effects on occultation by the right ascension of the ascending node of the satellite orbit, altitude of the orbit, time of year, and inclination of the spacecraft orbit to the earth equatorial plane are described. Of the four factors considered, variation with inclination of the orbit appears to be most significant if it is allowed to vary from 0 to 90 deg. It is shown that the two factors which influence occultation time for stars are the orbital altitude and the angle theta between the earth-star line and the orbital plane. For a fixed altitude the angle theta may be varied by altering orbital inclination or location of the node. For all stars for which the angle theta is approximately zero degrees, there is a long occultation time, and for all stars for which the angle theta is greater than approximately 72 degrees, there is no occultation. Author

N70-22934 Colorado Univ., Denver.
MAGNETIC FIELDS ASSOCIATED WITH SOLAR ACTIVE-REGION PROMINENCES
John Warren Harvey (Ph.D. Thesis) 1969 331 p
Avail: Univ. Microfilms: HC $15.10/Microfilm $4.25 Order No. 69-19540

An observational study of the magnetic fields in and around active region prominences is presented. The principal observational data consisted of about 200 measurements of the longitudinal magnetic field in active region prominences made with the High Altitude Observatory magnetograph using the H-alpha line. Observations of the longitudinal magnetic field of the chromosphere on the disk and the corona above active regions were also secured. The theory and practice of the measurements is discussed as well as recent modifications to the magnetograph. Noise sources were investigated. An attempt to achieve better spatial resolution was made by using photographic techniques. The reduction technique and theory of these observations are described. Methods for computing potential magnetic fields above active regions are discussed. Efforts to compute approximate force-free field configurations are outlined. Dissert. Abstr.

N70-23017 Colorado Univ., Boulder.
A MONTE CARLO CALCULATION OF RADIATIVE TRANSFER IN CYLINDERS WITH APPLICATION TO SOLAR SPICULES
Lorne Wallace Avery (Ph.D. Thesis) 1969 209 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-19519

The problem of radiative transfer in non-planar, inhomogeneous structures is difficult in view of the complexity of the transfer equation for such cases. Monte Carlo techniques, which are ideally suited to such problems, are developed and applied to cylindrical media. In the first part, considerable detail is devoted to developing the Monte Carlo method for the type of transfer problems of interest. The basic physical processes of importance and how one simulates them in a Monte Carlo scheme are discussed. The second portion is concerned with application of the method. Initially the transfer problem is isolated, homogeneous cylinders are studied to determine the effects of geometry upon the source function. A second application of the cylindrical calculations is to the problem of solar spicules. By comparing computed line profiles with the observed Calcium II K lines, a height-dependent temperature and density model of a spicule is derived. Dissert. Abstr.

N70-23092*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NEAR PARABOLIC SOLUTIONS OF THE TWO-BODY PROBLEM
R. H. Estes and E. R. Lancaster Mar. 1970 15 p refs Submitted for publication
(NASA-TM-X-63855; X-643-70-83) Avail: CFSTI CSCL 22C

The classical Kepler equations for the elliptical and hyperbolic cases of two body motion are examined. The classical method for solving Kepler's equation in the nearly parabolic region using a Gaussian iteration approach and auxiliary functional quantities is discussed. For the case of nearly parabolic motion, a universal Kepler equation is described which replaces separate equations for the elliptical, parabolic, and hyperbolic motion. The reverse calculation of the universal Kepler equation is also shown to be an efficient solution. S.S.

N70-23164*# Wolf Research and Development Corp., Riverdale, Md.
ERROR SENSITIVITY FUNCTION CATALOG
C. F. Martin and J. R. Vetter Washington NASA Mar. 1970 110 p refs
(Contract NAS6-1467)
(NASA-CR-1511) Avail: CFSTI CSCL 22C

The effects of various systematic errors on orbital solutions involving range, range-rate, azimuth and elevation observation are studied by analyzing the data reduction from the Wallops AN/FPQ-6 radar. The most significant error model terms are identified, and model recovery is considered both for single and multistation solutions. Several means by which the ORAN program is used in actual data reduction are demonstrated. It is concluded that short arc single station orbital solutions are seriously affected by systematic measurement errors. The measurement errors get propagated into the orbit, and may be only slightly evident in the measurement residuals. F.O.S.

N70-23221# European Space Research and Technology Center, Noordwijk (Netherlands).

HEOS 1: EARLY ORBIT ASSESSMENT

G. H. Booth, comp. Jul. 1969 87 p

(ESRO-TN-93-ESTEC) Avail: CFSTI

HEOS 1, the third ESRO satellite to be placed in orbit, was launched from the Eastern Test Range on a thrust-augmented, improved Thor/Delta at 18.55 hours on 5 December 1968; the purpose of the mission was the investigation of the magnetic field experienced and the energy distribution and directional properties of energetic particles in interplanetary space. The initial orbital parameters determined after the first perigee pass were found to be an apogee of approximately 223,500 km, a perigee of 431 km and an orbital inclination of 28.28 deg. The performance of the various spacecraft systems is assessed. In general, the experiments have not encountered any major problems and, apart from one or two minor discrepancies, no unexpected behaviour of the spacecraft subsystems was observed. Spacecraft and experiments seem to have had no adverse effect on each other's performance. Author (ESRO)

N70-23252*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE CONTROL OF MOTION DURING ENTRY INTO THE ATMOSPHERE [UPRAVLENIYE DVIZHENIYEM PRI VKHODE V ATMOSFERU]

D. Ye. Okhotsimskiy et al 4 Aug. 1969 12 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 7, no. 2, 1969 p 171–178

(Contract NAS7-100)

(NASA-CR-109334) Avail: CFSTI CSCL 22C

Results are presented of an investigation on the construction of an algorithm for the control of a spacecraft descending into the atmosphere at a second cosmic velocity. A multi-staged adaptive algorithm is constructed for control during the descent segment of the flight. Results are presented of the modeling operations of the algorithm in a digital computer. It is shown that the algorithm provided sufficient accuracy of control and smoothness in the adjustment process for the existence of significant variations in the distribution of the atmospheric parameters. Author

N70-23256# European Space Operations Center, Darmstadt (West Germany).

EXPANSION OF THE GEOPOTENTIAL IN ELLIPSOIDAL HARMONICS

H. G. Walter Feb. 1969 16 p refs

(ESRO-SR-11) Avail: CFSTI

The potential of the earth is developed in ellipsoidal harmonics, and the mathematical tools required, which are the generation of Lame's functions and the relationship between rectangular and ellipsoidal coordinates, are compiled. Brief reference is made to a procedure utilized for gravity coefficients determination in geopotential expansion of ellipsoidal harmonics when precise satellite tracking data are available. With the aim of carrying out a numerical integration of the Lagrangian equations of planetary motion, the functional dependence of the disturbing earth potential on the orbital elements for elliptic motion is given. In particular, formulas for the partial derivatives of the disturbing potential with respect to the orbital elements are derived, thus making possible the numerical calculation of these partial derivatives from orbital elements. Author (ESRO)

N70-23322*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY, REVISION 1

Gordon W. Solmon 10 Sep. 1968 149 p refs Revised

(NASA-TM-X-62831) Avail: CFSTI CSCL 22C

The launch vehicle operational trajectory for the AS-205/CSM-101 mission is presented. Included is a discussion of the predicted trajectory, mission objectives and constraints, and a tracking summary. Author

N70-23344# Defence Research Board, Ottawa (Ontario). Scientific Information Service.

PERTUBATION OF THE ORBITAL ELEMENTS OF A SYNCHRONOUS SATELLITE MOVING IN THE EARTH'S NONCENTRAL GRAVITY FIELD

S. G. Zhuravlev Aug. 1969 8 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III: Fiz.-Astron. (Moscow), no. 2, 1969 p 105–110

(T-527-R) Avail: CFSTI

Analytic formulas for the first-order perturbations of the Keplerian orbital elements of a satellite are derived when the unperturbed mean motion is equal to the Earth's angular velocity. It is shown that the ascending node of the orbit of a synchronous satellite under the influence of the Earth's equatorial flattening is displaced from east to west, while the perigee of the orbit evolves in the direction contrary to the direction of the satellite's orbital motion. F.O.S.

N70-23397*# National Aeronautics and Space Administration, Washington, D.C.

THE APOLLO 11 MISSION

Chester M. Lee *In* AGARD 5th AGARD Ann. Meeting Sep. 1969 p 33–35 (See N70-23391 10-34)

Avail: CFSTI CSCL 22A

Highlights of the flight and scientific results are reviewed. The anomalies of the mission are listed as communications dropout between the lunar module and ground just prior to and during the powered descent, the LM computer overloading during the descent, and touchdown four miles down range. Analysis of rock and soil samples, and the emplacement of a passive seismometer, a laser ranging retro reflector, and a solar wind composition experiment are described. N.E.N.

N70-23402 Texas Univ., Austin.

STABILITY OF AN HOMOGENEOUS ANISOTROPIC RELATIVISTIC COSMOLOGICAL MODEL

Jorge Krause Astorga (Ph.D. Thesis) 1968 15 p

Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-6172

The stability of the Kantowski-Sachs closed model against small perturbations of the metric tensor is investigated. Matter is represented by an irrotational dust source; no electromagnetic field is considered. A study of the comoving coordinate system used, and an analysis of the consequences, for the perturbed model, due to a change of gauge are given. The changes induced in the perturbation tensor by allowable infinitesimal transformations of coordinates are examined and, after presenting some hydrodynamic considerations on the behavior of an irrotational dust source, the remaining gauge freedom is stated. The perturbed Einstein field equations are constructed to the first order of approximation, assuming an irrotational dust source. The perturbation contributions to the metric and to the dust density are represented in their normal modes: the radial dependence is Fourier transformed, and the angular dependence is handled by means of tensor spherical harmonics. Using these harmonic representations, the system of linearized perturbed equations decouples into an 'even' modes system and an 'odd' modes system. The resulting equations are checked against gauge invariance. Dissert. Abstr.

N70-23412# Yerkes Observatory, Williams Bay, Wis.

[THE PROGRESS OF THE YERKES OBSERVATORY ASTROMETRIC PROGRAM] Annual Report, 1 Jul. 1968–30 Jun. 1969

William F. van Altena 30 Jun. 1969 10 p refs

(Contract N00014-67-A-0285-0004)

(AD-698809; AR-2) Avail: CFSTI CSCL 3/1

The progress of the Yerkes Observatory astrometric program is described. The principal result is an increase in accuracy of trigonometric parallaxes of a factor of three. A photoelectric image bisector developed at Yerkes Observatory is described, which has

made part of the increase in accuracy possible. Membership determination for several open clusters, presenitization of photographic plates and photometry with the Palomar Observatory Sky Survey prints are also discussed. Author (TAB)

N70-23434# Royal Aircraft Establishment, Farnborough (England).
ORBITAL STABILIZATION OF 12-HOUR SATELLITES
R. R. Allan Jul. 1969 29 p refs
(RAE-TR-69138) Copyright. Avail: CFSTI

Artificial earth satellites with periods of approximately 12 hours are subject to resonance effects similar to those suffered by synchronous satellites. The longitude-dependent terms in the geopotential produce long-term changes in the energy, i.e. in the semimajor axis, mean motion, and mean longitude. Highly eccentric 12-hour orbits at an inclination of about 6363 deg 4 (for which perigee precesses very slowly) are of special interest, since the apogee can remain in the Northern hemisphere. There is a stable state in which the ground track is fixed relative to the earth, and the position of the stable ground track depends on the argument of perigee omega and on the eccentricity. If the satellite is sufficiently near to commensurability, the ground track will librate about the stable position. Since there is scope for choice in the value of omega, it is possible to arrange that apogee occurs over Western Europe, for example. Such a satellite would be visible at a high angle of elevation from the whole of Western Europe for at least six hours. Author (ESRO)

N70-23451*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE SHUTTLE GUIDANCE
Wilton E. Causey 27 Feb. 1970 12 p ref
(NASA-TM-X-64500) Avail: CFSTI CSCL 22C

The guidance requirements for the Shuttle Vehicle and the possible candidate guidance schemes are discussed. The MASCOT Guidance Scheme appears to be ideally suited for the rendezvous guidance phase of the flight, and by modifying the guidance equation to include the lift and drag forces, the MASCOT scheme can be adapted for the ascent guidance phase. The basic parts of the MASCOT guidance scheme, a numerical integration algorithm and an iteration algorithm, can be used to develop a fast-prediction guidance scheme for the reentry phase. Author

N70-23459*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Engineering Mechanics Div.
BASIC AND MECHANICAL PROPERTIES OF THE LUNAR SOIL ESTIMATED FROM SURVEYOR TOUCHDOWN DATA
F. B. Sperling 15 Mar. 1970 14 p refs
(Contract NAS7-100)
(NASA-CR-109410; JPL-TM-33-443) Avail: CFSTI CSCL 03B

The results are presented of a study that was performed to estimate the following basic and mechanical properties of the lunar soil: (1) bearing strength, (2) effective friction coefficient, (3) bulk density, (4) internal friction angle, and (5) relative density. *Surveyor* landing telemetry data served as input; the method used was the analytical simulation of *Surveyor* landings with two analytical soil models. Author

N70-23463# Minnesota Univ., Minneapolis.
A SEARCH FOR FAINT BLUE STARS. I: PROPER MOTIONS FOR 951 FAINT BLUE STARS
Willem J. Luyten 10 Aug. 1969 23 p
(Contract Nonr-5060(00))
(AD-698306) Avail: CFSTI CSCL 3/3

Over the past twenty years motions of faint blue stars have been determined at the University of Minnesota. The document gives all proper motions derived for these stars. TAB

N70-23538*# Reilly Translations, Gardena, Calif.
DIAMETER AND DENSITY OF NEPTUNE [DIAMETR I PLOTNOST NEPTUNA]
B. Yu. Levin Pasadena, Calif. JPL 25 Nov. 1969 4 p Transl. into ENGLISH from Prioroda (Moscow), no. 6, 1969 p 77–78 Prepared for JPL
(Contract NAS7-100)
(NASA-CR-109335) Avail: CFSTI CSCL 03B

Calculations based on the 7 April 1968 occultation by Neptune of a star of 7.8 magnitude are presented. Neptune's diameter and density are determined to be 50,300 km and 1.6 g/cu cm, respectively. The height of the homogeneous atmosphere is 45 km, and at this altitude the temperature is 118 K and the density is approximately .000002 to .000005 g/cu cm. The new values are compared to earlier figures. N.E.N.

N70-23584*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE ORIGIN OF THE LUNAR CRATERS [DIE ENTSTEHUNG DER MONDKRATER]
Alfred Wegener 13 Feb. 1970 34 p refs Transl. into ENGLISH from German publ.
(Contract NAS7-100)
(NASA-CR-109327) Copyright. Avail: CFSTI CSCL 03B

Critiques of the bubble, tidal, volcanic, and impact hypotheses are presented in a study of the formation of lunar craters. Versions of the impact hypothesis from 1840 to date are reviewed, and the results of a systematic series of experiments testing the impact hypothesis are evaluated. The structure and origin of the meteor crater in Arizona is analysed as an impact crater. It is concluded that: (1) The lunar surface consists basically of dark, volcanic glass which light penetrates to only a slight depth. (2) The trajectories of impacting bodies were not in random order but lay in one principal plane, and were of low impacting velocities. (3) The highest temperatures existed in the zone of largest impacts, and heat was radiated into space. (4) The impacting bodies belonged to the solar system, and the impact phenomenon is related to the formation of the moon. F.O.S.

N70-23601# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
RADAR STUDIES OF THE SUN AND VENUS Final Report, 1 Jan. 1968 –2 Jun. 1969
Jun. 1969 22 p refs
(Grant NSF GP-8128)
(CSR-PR-0891-1) Avail: CFSTI

Reported is a radar study of the Sun and Venus. The solar radar studies indicate that the corona is heated by shocks moving at about 150 km/s at 1.5 solar radii. Irregularities of various sorts are also observed much higher in the corona. Author

N70-23657# Aztec School of Languages, Inc., Maynard, Mass.
PHOTOELECTRIC PHOTOMETRY OF ARTIFICIAL SATELLITES IN FRANCE [PHOTOMETRIE PHOTOELECTRIQUE DES SATELLITES ARTIFICIELS EN FRANCE]
J. H. Bigay et al Dec. 1969 7 p refs Transl. into ENGLISH from The Proc. of COSPAR, Plenary Meeting, Prague, 11-24 May 1969 Prepared for Lincoln Lab., MIT
(AZT-69-645-FRLL) Avail: CFSTI

A cooperative program of observations of the Pageos and Cosmos satellites at the Lyon Observatory is given in broad outline. The photometric instruments used are described. Pageos observations are rated as not very useful in view of the small area of the surface from which light is received. Cosmos satellites with long lifetimes, on the other hand, proved more satisfactory. Author

N70-23671# Entwicklungsring Nord, Bremen (West Germany).
TRAJECTORY MECHANICAL INVESTIGATIONS FOR THE PAYLOAD AUGMENTATION OF EUROPA 2 FOR A TWENTY-FOUR-HOUR ORBIT [BAHNMECHANISCHE UNTERSUCHUNGEN ZUR STEIGERUNG DER NUTZLAST VON EUROPA 2 FUER DIE 24H-BAHN]

H. Tolle and W. Wienss 1969 25 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

It is shown, by modification of the pitch angle program of the first stage, and by the choice of an elliptical instead of a circular free flight orbit that a considerable payload gain can be obtained for the launching rocket Europa 2, for 24-hour orbits, without any major technical modifications in the rocket itself. The payload augmentation is about 17.5% (corresponding to 30 kg) against the nominal ascent over a 300 km parking orbit and the standard control program of the first stage. The most favorable control program, after implementing a height temperature and loading restriction, is the following combination: vertical ascent time of 10 sec, and rotating the rocket in the trajectory plane with 0.603 deg/s to a final position angle of 17 deg. ESRO

N70-23682# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
THE PHYSICAL PROPERTIES OF THE LUNAR SURFACE [LES PROPRIETES PHYSIQUES DE LA SURFACE DE LA LUNE]
A. Dollfus Dec. 1969 21 p Transl. into ENGLISH from l'Aeronautique et L'Astronautique, v. 10, 1969 p 24-31 Prepared for Lincoln Lab., MIT
(AZT-70-68-FRLL) Avail: CFSTI

The physical properties of the surface of the lunar soil were first isolated by means of the classical method of astronomy. Since then considerable progress has been made by means of direct exploration by space probes. Author

N70-23714# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
CALCULATION OF TARGET TRAJECTORIES FROM RADAR OBSERVATION DATA TAKING INTO ACCOUNT THE RELATIONSHIP BETWEEN SUCCESSIVE READINGS [NAKHOZHDENIYE TRAYEKTORIJ TSELEY PO DANNYM RADIOLOKATSIONNOGO NABLYUDENIY PRI UCHETE SVYAZI MEZDU SOSEDNIMI OTSCHETAMI]
Ya. A. Furman Dec. 1969 22 p refs Transl. into ENGLISH from Tr. Mosk. Aviats. Inst. (Moscow), no. 178, 1968 p 33-48 Prepared for Lincoln Lab., MIT
(AZT-69-663-RULL) Avail: CFSTI

The process of determining target trajectory with the aid of a prediction formula using only the connection between successive readings is examined. Errors in prediction which arise are determined either from the effect of single false alarms or from dynamic errors arising from failure to consider the relationship between the initial trajectory increments. Author

N70-23777# Aztec School of Languages, Inc., Maynard, Mass.
DETERMINATION OF THE A POSTERIORI PROBABILITY OF A TARGET POSITION ACCORDING TO THE DATA OF RADAR OBSERVATION [OPREDELENIYE APOSTERIORNOY VEROYATNOSTI POLOZHENIYA TSELI V PROSTRANSTVE PO DANNYM RADIOLOKATSIONNOGO NABLYUDENIYA]
Ya. A. Furman Oct. 1969 16 p refs Transl. into ENGLISH from Teorii i Tek. Radiolokatsii, (USSR), no. 2, 1968 p 23-33 Prepared for Lincoln Lab., MIT
(AZT-69-660-RULL) Avail: CFSTI

This problem is associated with the utilization both of space and of time variables and with the necessity of observing a number of objects in the sector of the radar scanning system. This type of trajectory is characterized by very large values of the velocity and acceleration of the object and by a weak statistical relationship between the readings. Representation of the *a posteriori* probability distribution of the location of an object in space in the form of a vector-line of probabilities of a Markov chain permits analyzing the problem of an optimal interconnection of data for a large class of trajectories of motion of an object and also obtaining a series of important characteristics of motion of the object. Author

N70-23812*# Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Science.
A GENERAL REVIEW AND DISCUSSION ON GEODETIC CONTROL OF THE MOON, PHASE 1 Final Report
Ivan I. Mueller, ed. Dec. 1969 136 p
(Contract NAS9-9695; OSURF Proj. 2841)
(NASA-CR-108301; Rept-127) Avail: CFSTI CSCL 03B

The state of the art in selenodetic control is studied for application to the following systems: (1) Lunar Orbiter and Apollo photography; (2) Apollo navigation; (3) lunar motion effects; (4) lunar orbit determination and lunar gravity field; (5) earth-based selenodetic information; and (6) observational systems useful for selenodesy. Together with a summary of the state of the art for each problem a relevant bibliography is included. G.G.

N70-23862# Royal Greenwich Observatory, Herstmonceux (England).
RADIAL VELOCITIES OF STARS OF SPECTRAL TYPES A AND F
D. H. P. Jones and C. Margaret Haslam 1969 15 p refs Prepared jointly with Roy. Obs., Cape Town *Its* Roy. Obs. Bull. No. 155
Avail: CFSTI

Radial velocities are presented for twenty seven stars with spectral types between A sub 5 and F8. The plates were exposed with the grating spectrograph on the 36-inch reflector at Herstmonceux, using the f/1.75 camera at 86 A/mm. The lines measured include some in the near ultraviolet not previously used for radial-velocity determination. Fresh wavelengths are derived for all the lines. The accuracy achieved is closely comparable with that obtained by other observatories. Six stars were intensively observed to investigate short period variability. One of them, HD 107904, is a delta Scuti variable. Upper variation limits are given for the other five. Author (ESRO)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N70-22552# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
COMPARISON OF THEORETICAL AND EXPERIMENTAL ATTITUDE DATA FOR THE DODGE SPACECRAFT
J. Whisnant, Pisacane Miller, and L. Vincent Aug. 1969 58 p refs
(Contract NOw-62-0604-C)
(AD-697903; APL-TG-1076) Avail: CFSTI CSCL 22/2

The DODGE satellite, launched in July 1967, has successfully achieved gravity-gradient stabilization at near synchronous altitudes. Extendible booms, a constant-speed rotor, and four damping systems provide the opportunity to perform many attitude stabilization experiments. One of the objectives of the DODGE experiment was to determine the adequacy of theoretical analyses by correlation between simulation results and experimental data. This paper presents a comparison between the measured attitude and the results of digital simulation of the equations of attitude motion. Agreement between the two is varied. The digital simulation is also used to investigate possible causes of anomalous attitude behavior. It is shown that boom non-straightness has a significant effect on attitude performance, but that erroneous magnetometer readings of the type that were recorded in orbit do not. Author (TAB)

N70-22781*# General Motors Corp., Milwaukee, Wis. AC Electronics Div.
TESTING ON G AND N NON-METALLIC MATERIALS IN

AN OXYGEN ATMOSPHERE: CATEGORIES B, E, F, AND H Final Report
1 Jun. 1967 126 p
(Contract NAS9-497)
(NASA-CR-108318) Avail: CFSTI CSCL 22B

Flammability tests were conducted to evaluate the combustion characteristics of Apollo guidance and navigation nonmetallic materials applications in pure oxygen atmospheres. These tests were carried out with a combination of dummy units, simulated units, and actual airborne equipment. Testing was performed in an oxygen chamber with a volume of approximately 200 cubic feet. Tests were observed visually and recorded on motion pictures and test data sheets. Test chamber conditions and test input levels were monitored on chart recorders. Quality conrol monitoring was used for the majority of the tests. Author

N70-22830*# Martin Marietta Corp., Denver, Colo.
STUDY OF SPACE STATION PROPULSION SYSTEM RESUPPLY AND REPAIR Monthly Progress Report, 1 Jan. –1 Feb. 1970
1 Feb. 1970 33 p
(Contract NAS8-25067)
(NASA-CR-102542; MCR-69-422; MPR-5) Avail: CFSTI CSCL 22B

The design of separable connectors is discussed in this progress report and concepts are presented for fittings that are adaptable to inflight maintenance. A propellant toxicity analysis was conducted to evaluate the effects of propellant spillage and leakage within the space station. The analysis concluded that the propellant system must be isolated from the crew quarters and that no leakage is permissible into the space station. It was concluded that large quantities of propellant and nitrogen leakage could be tolerated if the leakage were directed to vacuum. Propellant vapors must be collected in a device such as a cold trap to prevent external contamination to the space station. Detailed data on leakage criteria is outlined. Weight comparisons were made for the five resupply systems, and it was concluded that the total weight variation in the five systems was minimal (50 pounds). Author

N70-22901*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CONCEPTUAL DESIGN OF A HIGH ENERGY ASTRONOMY OBSERVATORY. VOLUME 1: PRELIMINARY ANALYSIS. VOLUME 2: APPENDICES
16 Feb. 1970 753 p refs
(NASA-TM-X-53976) Avail: CFSTI CSCL 22A

The preliminary analysis and conceptual design of a baseline spacecraft are presented, along with supporting technical data and discussion of mission and spacecraft alternatives. For individual titles, see N70-22902 through N70-22923.

N70-22903*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LAUNCH VEHICLE
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 38 p refs (See N70-22901 10-31)
Avail: CFSTI CSCL 22B

Selection of the Titan 3D launch vehicle was based on the use of the lowest cost existing system with sufficient payload capability. The basic Titan 3D launch vehicle is described and the modifications required to adapt it for the HEAO missions to be launched from the Eastern Test Range are discussed. The launch vehicle capabilities and the environments which the payload will experience are presented and the payload shroud and its interface with the launch vehicle and the payload are discussed. Author

N70-22906*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACECRAFT DESIGN
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 40 p ref (See N70-22901 10-31)
Avail: CFSTI CSCL 22B

Several competing approaches were examined for each aspect of the mission and hardware design, and one concept was selected for the 'baseline' design, baseline being understood as the design concept to which the most detailed effort was devoted in the Phase A study. Final spacecraft design depends on the specific experiments to be included in the mission. The various systems designated for the spacecraft are identified and described and the interfaces included in the spacecraft are discussed. System weight and power growth trends and system capability improvement are outlined. R.B.

N70-22907*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THERMAL SYSTEM DESIGN
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 22 p refs (See N70-22901 10-31)
Avail: CFSTI

Preliminary results are presented for an effectiveness analysis of the HEAO thermal control system. The analysis consists of establishing characteristic parameters associated with the thermal control system, determining the values of the parameters, and generating a numerical measure of effectiveness for two thermal control concepts for the satellite. The values of the characteristic parameters were related to the solar arrays only. The thermal control concepts analyzed consist of a baseline system which utilized paint only. The vehicle configuration was the baseline consisting of the solar arrays mounted to the sides of the spacecraft with the center panel perpendicular to the sunline. Author

N70-22912*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MISSION OPERATIONS
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 10 p (See N70-22901 10-31)
Avail: CFSTI CSCL 22D

The following elements are included in the HEAO mission operations system: plans, systems, interfaces, time-phased sequence of events, procedures, and facilities necessary to perform launch and flight operations planning; produce mission software; operate launch and mission control facilities, monitor and control the launch vehicle, spacecraft, and experiments during launch operations and in flight; obtain data for operational control and management of acquisition; and process and distribute launch and mission control and experiment data. Author

N70-22915*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LAUNCH VEHICLE ALTERNATIVES, APPENDIX B
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 27 p refs (See N70-22901 10-31)
Avail: CFSTI CSCL 22B

Because of various considerations, selection of the launch vehicle for the HEAO mission was narrowed to the Titan 3D and Titan 3C. The Titan 3D vehicle was selected as the baseline launch vehicle due to overall cost effectiveness and the Titan 3C as the primary alternate. Performance capability data are compared for both launch vehicles. R.B.

N70-22917*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ALTERNATE CONFIGURATIONS, APPENDIX D
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 21 p (See N70-22901 10-31)
Avail: CFSTI CSCL 22B

Several alternate spacecraft configurations were studied for their ability to provide power growth capability, to reduce spacecraft length, weight, and deflection during launch, and to

examine different packaging arrangements. The configurations were divided into three classes on the basis of their solar array design. Different types of solar arrays are shown, including a fixed solar array, side oriented toward the sun, deployable arrays, side oriented toward the sun, and deployable arrays, end oriented toward the sun. The major advantages and disadvantages of each configuration class are discussed. Author

N70-23212*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EJECTION OF INTERNAL MASS FROM SPINNING SPACECRAFT WITH COLLISION INTERACTIONS

Franz Zach Jan. 1970 43 p Submitted for publication

(NASA-TM-X-63860; X-734-70-50) Avail: CFSTI CSCL 22A

Ejection of internally stored mass (e.g. an apogee motor casing) from a spinning spacecraft wherein a collision occurs is treated. The problem is attacked by formulation of two processes: first, an ejection process which includes the release mechanism, the separation trajectory of stored mass relative to spacecraft, and the determination of the collision point; and second a collision process wherein the impulse exchanged is computed based upon consideration of surface friction, mechanical deformations, and coefficient of restitution. A specific case is treated where both direction and magnitude of spacecraft body rates following collision are determined as functions of the collision parameters. A knowledge of these body rates is required to perform directional despin of a spacecraft about its final axis of maximum moment of inertia. Author

N70-23277*# Thiokol Chemical Corp., Denville, N.J. Reaction Motors Div.

PROPELLANT EXPULSION BLADDER FOR THE SATURN S/S-4B Final Report, 1 Jul. 1967 –30 Jun. 1969

R. L. Heilman 30 Jan. 1969 105 p refs

(Contract NAS8-21149)

(NASA-CR-102576; RMD-5125-F) Avail: CFSTI CSCL 13D

A nitrogen tetroxide resistant positive expulsion bladder consisting of a laminated structure of electroformed gold and carboxy nitroso rubber (CNR) was developed. A formulation of CNR suitable for the application was defined. A satisfactory goldplating procedure was developed and defined. Development of an interlaminant adhesive system included extensive evaluation of state-of-the-art adhesives, CNR liquid polymer and NR copolymer. Resistance to delamination throughout five weeks exposure to N2O4 was demonstrated. Bond strengths of 3.6 pounds per lineal inch (pli)were achieved with an N2O4 compatible adhesive system. Variations in bond strength affected by humidity, N2O4 vapor and liquid N2O4 are discussed. Development of a CNR coating technique for bladder fabrication included evaluation of spraying and brush coating. Using brush coating procedures, completely void free CNR films were fabricated. Four six inch diameter subscale bladders and one full scale RCS bladder were fabricated. Tests on subscale bladders included water expulsion tests and N2O4 expulsion tests; also seven day N2O4 storage tests with no detrimental effects. Author

N70-23348*# Martin Marietta Corp., Denver, Colo.

DEVELOPMENT OF ADVANCED MATERIALS FOR INTEGRATED TANK INSULATION SYSTEM FOR THE LONG TERM STORAGE OF CRYOGENS IN SPACE Final Report

John P. Gille Sep. 1969 171 p refs

(Contract NAS8-21330)

(NASA-CR-102570; MCR-69-405) Avail: CFSTI CSCL 13D

The use of nonmetallic composite materials in the tank support structure, was considered as a means of reducing heat input to the tank. Thermal conductivity tests were conducted for S-glass epoxy, boron epoxy, and graphite epoxy composites. Thermal conductances were also measured for a self-aligning spherical bearing and a stacked washer assembly. A concept for applying tension and compression loads to nonmetallic fibers, particularly boron, was developed and evaluated in preliminary feasibility for tank supports results in an improvement in heat lack of 60% or more over the reference vehicle configuration. A concept for interposing a layer of hydrogen vapor between the liquid and tank wall in the vicinity of concentrated heat input, such as the feed line penetration, was considered. A capillary internal insulation concept using nonmetallic honeycomb to position gas adjacent to the tank wall was found to lack promise for long-term hydrogen storage applications. Author

N70-23469*# North American Rockwell Corp., Downey, Calif. Space Div.

SOLAR ELECTRIC PROPULSION ASTEROID BELT MISSION STUDY. VOLUME 1: SUMMARY REPORT Final Report

S. P. Horio Jan. 1970 118 p Prepared by Hughes Research Labs. for JPL

(Contracts NAS7-100; JPL-952566)

(NASA-CR-109342; SD-70-21-1) Avail: CFSTI CSCL 22A

This three-volume report presents the final study results of an asteroid belt mission using a solar electric propulsion spacecraft. The asteroid belt, located between the orbits of Mars and Jupiter, and its potential hazards to spacecraft, are of considerable scientific and engineering interest. The solar electric propulsion system in this study is based on rollup-type solar cell arrays, mercury electron bombardment ion thrusters, and associated power conditioning and control units. Mission and system analyses are presented which show the rationale for selecting a 3.5 AU aphelion trajectory, a 7.8 kw electric propulsion system with specific impulse of 3500 seconds, and an Atlas/Centaur to launch the electric propulsion spacecraft. Results of spacecraft design studies show the configuration tradeoffs and subsystems design analysis leading to a 1600-pound recommended electric propulsion spacecraft concept capable of accommodating more than 750 sq feet of particle penetration detectors. The program development plan describes the orderly activities for the development and delivery of one or two flight-qualified spacecraft. Author

N70-23470*# North American Rockwell Corp., Downey, Calif. Space Div.

SOLAR ELECTRIC PROPULSION ASTEROID BELT MISSION STUDY. VOLUME 2: TECHNICAL REPORT Final Report

E. H. Richardson Jan. 1970 588 p refs

(Contract NAS7-100; JPL-952566)

(NASA-CR-109338; SD-70-21-2) Avail: CFSTI HC $10.00/MF $0.65 CSCL 22B

An asteroid belt mission was studied using a solar electric propulsion spacecraft. The asteroid belt, located between the orbits of Mars and Jupiter, is of major scientific interest; its potential hazards to spacecraft are of major concern. The solar electric propulsion system described is based on roll-up type solar cell arrays, mercury electron bombardment ion thrusters, and associated power conditioning and control units. Mission and system analyses showed the rationale for selecting a 3.5-AU aphelion trajectory, a 7.8-kilowatt electric propulsion system with specific impulse of 3500 seconds, and an Atlas/Centaur to launch the electric propulsion spacecraft. Results of spacecraft design studies show the configuration trade-offs and subsystem design analysis leading to a 1600-pound recommended electric propulsion spacecraft concept capable of accommodating more than 750 sq feet of particle-penetration detectors. The program development plan describes an orderly plan of activities for the development and delivery of one or two flight qualified spacecraft and the associated cost estimate of $74.5 million for two spacecraft to be launched in 1975. Author

N70-23471*# North American Rockwell Corp., Downey, Calif. Space Div.

SOLAR ELECTRIC PROPULSION ASTEROID BELT

MISSION STUDY. VOLUME 3: PROGRAM DEVELOPMENT PLAN Final Report
F. G. Springer 19 Jan. 1970 230 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952566)
(NASA-CR-109349; SD-70-21-13) Avail: CFSTI CSCL 22A
For abstract see Acc. No. N70-23470.

N70-23548*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
OPTICAL SATELLITE-TRACKING PROGRAM Semiannual Progress Report, 1 Jul. – 31 Dec. 1969
31 Dec. 1969 36 p refs
(Grant NGR-09-015-002)
(NASA-CR-109361; SAPR-21) Avail: CFSTI CSCL 22A

The research and developments for this period are reported. Included are the activities in the geodetic and atmospheric investigations, the satellite-tracking and data acquisition, and data reductions for GEOS 1. Recent papers and special reports are listed. F.O.S.

N70-23553# Wissenschaftliche Gesellschaft fuer Luft- und Raumfahrt, Munich (West Germany).
ROCKET TECHNOLOGY [RAKETENTECHNIK]
Sep. 1969 101 p refs In GERMAN Proc. of the 8th WGLR Meeting, Munich, 13 Dec. 1967
(DLR-MITT-69-16) Avail: CFSTI

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1. THE GERMAN STAGE IN THE ELDO-A ROCKET LAUNCH SYSTEM J. Carl (Boelkow G.m.b.H) p 9–21 (See N70-23554 10-31)

2. DIFFERENT ASPECTS OF VERTICAL ASCENT OF LAUNCH VEHICLE SYSTEMS H. Tolle (Entwicklungsring Nord) p 23–44 refs (See N70-23555 10-31)

3. THE CARRIER PLANE AS A LAUNCHING BASE FOR SPACE VEHICLES K. Reiniger (Boelkow G.m.b.H.) p 45–77 (See N70-23556 10-31)

N70-23554# Boelkow G.m.b.H., Ottobrunn bei Muenchen (West Germany).
THE GERMAN STAGE IN THE ELDO-A ROCKET LAUNCH SYSTEM [DIE DEUTSCHE STUFE IM ELDO-A-RAKETENSTARTSYSTEM]
J. Carl *In* WGLR Rocket Technol. Sep. 1969 p 9–21 In GERMAN (See N70-23553 10-31)
Avail: CFSTI

The history of the development of the ELDO-A launch vehicle is described and special emphasis is laid on the third stage and its equipment. A description of the countdown procedures and future developments is also given. ESRO

N70-23555# Entwicklungsring Nord, Bremen (West Germany).
DIFFERENT ASPECTS OF VERTICAL ASCENT OF LAUNCH VEHICLE SYSTEMS [GESICHTSPUNKTE ZUM SENKRECHTEN AUFSTIEG VON RAUMFAHRTTRAEGERSYSTEMEN]
H. Tolle *In* WGLR Rocket Technol. Sep. 1969 p 23–44 refs In GERMAN (See N70-23553 10-31)
Avail: CFSTI

The physical basis and problems encountered with vertical launch vehicle takeoff are discussed and attempts are made to define optimal conditions. Vertical and horizontal takeoffs are compared but the complexity of the problem prevents clear-cut conclusions from being reached. ESRO

N70-23556# Boelkow G.m.b.H., Ottobrunn bei Muenchen (West Germany).
THE CARRIER PLANE AS A LAUNCHING BASE FOR SPACE VEHICLES [DAS TRAEGERFLUGZEUG ALS STARTBASIS FUER RAUMFLUGKOERPER]
K. Reiniger *In* WGLR Rocket Technol. Sep. 1969 p 45–77 In GERMAN (See N70-23553 10-31)
Avail: CFSTI

The possibility of satellite launchings from subsonic, supersonic and hypervelocity aircraft is discussed. It is shown that even with a subsonic aircraft about 1000 m/s of characteristic velocity can be saved and solutions using existing or modified carrier planes are discussed. A solution which would be suitable for European projects is presented and analyzed. ESRO

N70-23581# McDonnell-Douglas Co., Hungtington Beach, Calif. Space Systems Center.
LUNAR CARGO DELIVERY SYSTEM: A CASE STUDY OF THE SYSTEMS CONCEPT
H. Stoewer Sep. 1969 59 p refs Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
(MDAC-WD-1101) Avail: CFSTI

A launch system capable of supporting post-Apollo lunar missions demonstrates the life cycle of a typical space project from the conception of the idea to the production and operation of the hardware. Three specific system development models are discussed. Application of the systems concept is shown within the boundaries of a simplified model, which contains a systems analysis and a program definition phase. The Lunar Cargo Delivery Systems (LCDS) is a five stage launch vehicle which utilizes a Saturn 1B booster and a Centaur velocity stage. The fourth and fifth stages are used to brake and soft land on the lunar surface. Author (ESRO)

N70-23606*# Scientific Translation Service, Santa Barbara, Calif.
FOR "CHEAP" TRANSPORTATION THROUGH SPACE [POUR UN TRANSPORT SPATIAL 'BON MARCHE']
Washington NASA Mar. 1970 8 p Transl. into ENGLISH from Rech. Spatiale (Paris), v. 8, no. 11, Nov. 1969 p 17–19
(Contract NASw-2035)
(NASA-TT-F-12880) Avail: CFSTI CSCL 22B

The costs of operation of the Saturn V, SST, Boeing 707 and other vehicles are compared with the NASA budget and the gross national product of the United States. The cost of orbiting a payload is discussed as a function of payload weight. It is shown that a single stage, recoverable space vehicle should be developed on economic grounds. Launch vehicles must be standardized and planned at least 10 years before they are put into operation. Author

N70-23759# Royal Aircraft Establishment, Farnborough (England).
OIL - VAPOUR CONTAMINATION OF SATELLITE OPTICAL SURFACES
T. N. Williams Mar. 1969 22 p ref
(RAE-TR-69055) Copyright. Avail: CFSTI

The effects of oil vapor contamination on satellite optical surfaces when exposed to high vacuum and ultraviolet irradiation were investigated. The oil coatings, when exposed to ultraviolet radiation under vacuum, caused severe and apparently permanent degradation of optical performance in the ultraviolet region of the electromagnetic spectrum. It is concluded that no oil or grease should be used in satellite mechanisms which are near optical surfaces used for measurements in the ultraviolet. Author (ESRO)

N70-23767# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
INFLUENCE OF AERODYNAMIC BRAKES ON THE AERODYNAMIC COEFFICIENTS OF THE FIRST REENTRY STAGE OF THE REUSABLE BALLISTIC ROCKET 'NEPTUN' [EINFLUSS DER BREMSKLAPPEN AUF DIE AERODYNAMISCHEN BEIWERTE DER ERSTEN WIEDEREINTRITTSSTUFE DER WIEDERVERWENDBAREN TRAEGERRAKETE 'NEPTUN']
Hansgeorg Riedel and Hans Emunds Oct. 1969 52 p refs

In GERMAN; ENGLISH summary
(DLR-FB-69-73) Avail: CFSTI

The influence of the angle of deflection of the brakes on the aerodynamic coefficients of the first reentry stage of the space transportation system Neptun was determined in the 30 x 30 sq cm supersonic wind tunnel over the Mach number range M = 2.25 to 4.15 and the results are discussed. Author (ESRO)

N70-23807# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Hauptabteilung Raumfahrt.
COMPARISON OF THE RESULTS OF SPACE SIMULATION TESTS WITH ANALYTICAL INVESTIGATIONS OF THE AZUR SATELLITE [VERGLEICH DER WELTRAUMSIMULATIONSTESTERGEBNISSE MIT DEN ANALYTISCHEN UNTERSUCHUNGEN BEIM SATELLITEN AZUR]
K. Koegler 1969 16 p In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

The results obtained from iterative space simulation tests on the AZUR satellite were compared with the analytical results for the temperature control of the satellite. The temperature values were determined experimentally by means of thermocouples and these values were coordinated with a 117 point node model. The heat transfer between the modules of the satellite was determined by means of preliminary tests to obtain safe input data. ESRO

N70-23848*# National Aeronautics and Space Administration, Washington, D.C.
APOLLO 10 BRIEFING: NEWS RELEASE
14 Apr. 1969 84 p
Avail: NASA Scientific and Technical Information Division

A transcript of the pre-flight Apollo 10 briefing is presented. Charts and tables of mission operational parameters are included. D.L.G.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N70-22531 British Ship Research Association, Wallsend (England).
ON THE DESIGN OF FIBREGLASS REINFORCED PLASTIC SHIP HULL STRUCTURES
M. Takehanna et al [1968] 16 p refs Transl. into ENGLISH from J. Soc. Nav. Arch. (Japan), v. 123, Jun. 1968 p 196
(NLL-BSRA-Trans-3078) Avail: BSRA, Wallsend Engl.: £5

Guidelines based on analyses of data from previous experiments on boats constructed from fiberglass-reinforced plastics (FRP) are proposed for structural design. Methods of calculating the rigidity of FRP laminated plates are presented according to normal theories of anisotropic laminates. The large deflection of orthtropic plates under loads of even distribution are compared with results of panel tests using the approximations of orthotropic membranes. R.B.

N70-22559# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.
TORSIONAL VIBRATION OF AN ELASTIC SOLID CONTAINING A PENNY SHAPED CRACK
G. C. Sih and J. F. Loeber Oct. 1969 33 p refs
(Contract N00014-68-A-514)
(AD-698839; TR-2) Avail: CFSTI CSCL 20/11

The axisymmetric wave equation is solved for the problem of torsional elastic waves impinging on a penny-shaped crack the periphery of which is assumed to be infinitely sharp. Using Hankel transforms, the problem is reduced to the solution of two simultaneous integral equations of the Fredholm type. The proposed method of solution permits an examination of the complete scattered-wave field at points both near to and far from the penny-shaped plane of discontinuity. In elastodynamics, however it is the near-field stress solution that is of chief interest. To this end, the singular nature of the local dynamic stress field is determined in elementary closed form, while the magnitude of this stress field, which can be adequately described by a singularity parameter, is calculated numerically. A knowledge of this parameter is essential to a clear understanding of the propagation of cracks through structural components undergoing torsional oscillations, since its value has been known to control the stability or instability behavior of cracks. Author (TAB)

N70-22582 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATIONS INTO THE STRESSES BETWEEN INDIVIDUAL WIRES OF STRANDED ROPE [ISSLEDOVANIE KONTAKTNYKH NAPRYAZHENII V PROVOLOKAKH SPIRAL'NOGO KANATA LINEINOGO KASANIYA]
P. P. Nesterov et al 22 Oct. 1969 9 p refs Transl. into ENGLISH from Izv. Vysah. Ucheb. Zaved., Gorn. Zhur (USSR), v. 12, no. 12, 1968 p 100-103
(NLL-SMRE-Trans-5713-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The results are given of investigations on the stresses in wires of a stranded rope due to a linear interaction between individual wires under terminal load. The studies were carried out on the whole of the wire cross-section, but only linear contact between the strands is examined. By determining the contact tensions in wire ropes, a more complete representation of the stressed state of the wires was obtained. The contact stresses attain a considerable value and cannot be ignored in calculations of rope strength. Author

N70-22589# Sandia Corp., Albuquerque, N. Mex.
SWAP-9: AN IMPROVED STRESS WAVE ANALYZING PROGRAM
L. M. Barker Aug. 1969 175 p refs
(PB-187295; SC-RR-233) Avail: CFSTI CSCL 20K

The SWAP-9 computer program for solving stress-wave problems in one-dimensional strain is the result of numerous improvements to SWAP-7. The new version of SWAP retains all of the capabilities of SWAP-7, i.e., it handles both hydrostatic and elastic-plastic materials, can incorporate such effects as work hardening, changes in elastic constants and yield strength with pressure and internal energy, and spall at a given tensile stress. In addition, SWAP-9 can treat detonations, gases, and vaporization of solids resulting from radiant energy deposition. A number of equation of state options have been written into the program to correspond to those available in the WONDY finite difference program. Author (USGRDR)

N70-22582# California Univ., Berkeley. Earthquake Engineering Research Center.
EARTHQUAKE ENGINEERING RESEARCH AT BERKELEY Conference Papers
Jan. 1969 234 p refs Presented at the 4th World Conf. on Earthquake Eng., Santiago, Chile, Jan. 1969
(PB-187906; EERC-69-1) Avail: CFSTI CSCL 13M

Research in earthquake engineering includes: Design and research potential of two earthquake simulator facilities; Seismic behavior of steel beam to column connector subassemblages; Reliability of steel beam-to-column connections under cyclic loading; Damping capacity of a model steel structure; Pore-water pressures in earth slopes under seismic loading conditions; Earthquake analysis

of earth dams; Influence of geometry and material properties on the seismic response of soil deposits; A method of analysis for the evaluation of foundation-structure interaction; Earthquake analysis of reservoir-dam systems; Dynamic earthquake behavior of shell roofs; Dam-foundation interaction during earthquakes. USGRDR

N70-22598*# Syracuse Univ. Research Inst., N.Y. Dept. of Chemical Engineering and Metallurgy.
CRACK INITIATION AT NOTCHES IN LOW CYCLE FATIGUE Final Report, 1 Aug. 1968 –15 Mar. 1969
V. Weiss, M. Ogasawara, M. Adachi, and J. Sessler Mar. 1969 57 p refs
(Grant NGR-33-022-023)
(NASA-CR-72682; MET-E-1313-15369-F) Avail: CFSTI CSCL 20K

An experimental study of the plastic strain distribution near notches was undertaken to aid in the analysis of low cycle fatigue crack initiation. The results indicate that the plastic strains have nearly the same dependence on distance from the notch root as do the theoretical elastic strains. This similarity between elastic and plastic strain distribution for AM 350 steel sheet is further confirmed by the experimental result that the true strain concentration factor is approximately equal to the elastic stress concentration factor, and is certainly related to the strain hardening behavior of the test material. Analyses of the present data on crack initiation in 7075-T6 aluminum show that a Manson–Coffin type relationship exists, provided that plastic constraint is taken into account. The energy loss per cycle, as determined from the hysterisis loops, may also serve as a useful parameter in the analysis of crack initiation. The data show that the product of energy loss per cycle and number of cycles to crack initiation is constant. Author

N70-22609 Texas A&M Univ., College Station.
ON STRESSES AND DEFORMATIONS IN ANISOTROPIC TOROIDAL SHELLS SUBJECTED TO UNIFORM INTERNAL PRESSURE
Arnold Norman Levine (Ph.D. Thesis) 1968 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-8488

An analysis of a thin toroidal shell of circular cross section, constructed from a plane anisotropic material and subjected to uniform internal pressure, is conducted with the use of linear bending theory. The analysis leads to a set of two simultaneous, linear, second-order differential equations with variable coefficients, the solution to which yields relationships describing the structural behavior of the middle surface of the shell. A closed form solution, using the method of asymptotic integration, is obtained for the differential equations for an orthotropic material. Engineering formulas for the stress resultants, stress couples, and deformations, applicable to an orthotropic and isotopic material, are presented. Dissert. Abstr.

N70-22613 Yale Univ., New Haven, Conn.
STABILITY OF A CLAMPED ELASTIC PLASTIC COLUMN SUBJECTED TO LOAD AND A TRANSVERSE TEMPERATURE GRADIENT
Li-Chung Tao (Ph.D. Thesis) 1968 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-8444

A theoretical and experimental analysis of a clamped elastic perfectly plastic column subjected to a transverse temperature gradient is presented. The analysis of a model of the column is also included to illustrate the main characteristics of the buckling process without the mathematical complexity of the column. It is shown that the column can start to bend for any load between two critical loads. The lowest of these critical loads is analogous to the tangent modulus load for a work hardening column. The load deflection curves starting from this load are determined to obtain the maximum load the column can carry. It is found that the maximum load is equal to or slightly greater than this critical load. Good agreement is obtained between the experimental and theoretical results. Dissert. Abstr.

N70-22617 Northwestern Univ., Evanston, Ill.
CONTINUOUS DISTRIBUTIONS OF DISLOCATIONS IN JOINED HALF-SPACES
Chia-Fong Hsieh (Ph.D. Thesis) 1968 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-6941

Two different methods are presented for solving the problems of continuous distributions of dislocations in joined half-spaces with a perfectly bonded interface. In the light of the existing solution for a whole space subjected to a three-dimensional periodic distribution of dislocations, a technique of superposition has been developed to obtain the solution of a three-dimensional periodic distribution of dislocations in joined half-spaces. The problem of a two-dimensional periodic distribution of dislocations in joined half-spaces is solved by the standard mathematical method in boundary value problems. The application of the proposed theory is demonstrated by the solution of an infinite straight screw dislocation perpendicularly piercing a bimetallic interface. The applicability of the processes of the proposed methods to continously distributed dislocations in joined half-spaces with a smooth interface is also discussed. Dissert. Abstr.

N70-22620# Texas Transporation Inst., College Station.
ANALYTICAL METHODS APPLIED TO THE MEASUREMENTS OF DEFLECTIONS AND WAVE VELOCITIES OF HIGHWAY PAVEMENT. PART 2: MEASUREMENTS OF WAVE VELOCITIES Research Report
W. H. Cogill Mar. 1969 91 p refs Sponsored by US Dept. of Transportation
(PB-186458; RR-32-15F) Avail: CFSTI CSCL 13B

The Shell vibrator has been used to investigate the behavior of a number of highway structures. Measurements have been made of the wavelength at the free surface over a range of frequencies. It is found that the phase velocity of the wave is not constant but varies with the frequency. It is anticipated that the manner of the variation of the velocity relates to some of the physical properties of the structure. The object of the work was to determine what information can be obtained from the frequency-dispersion curves of phase velocity which have been obtained during the experimental work. Ultimately, it is desired to deduce, in numerical terms, values of the structural parameters, such as the interface depths of the layers composing the system and the elastic constants of the materials composing the layers. Author (USGRDR)

N70-22640 Stanford Univ., Calif.
THE INTERPRETATION OF PLASTIC DEFORMATION AT ELEVATED TEMPERATURES IN TERMS OF MEASURED EFFECTIVE STRESSES
Alvin Arnold Solomon (Ph.D. Thesis) 1968 200 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-8271

The microdynamics of elevated temperature deformation in single and polycrystalline Fe-3% Si and high purity polycrystalline aluminum is examined. Effective stresses are obtained based upon the response of dislocations to the internal and applied stresses. Primary and steady state creep are examined with respect to the measured minimum effective stresses. Modified stress relaxation and strain rate sensitivity techniques are used to study dislocation velocity at elevated temperatures. Dislocation density measurements are made in both steady state creep and stress relaxation experiments and are related to measured effective stresses. The dislocation model provides the rate-controlling process in steady state creep based upon the time the dislocations spend in the glide or climb mode, and also for the differences between stress relaxation and strain rate sensitivity tests, and the steady state creep process. Dissert. Abstr.

N70-22674*# North Carolina State Univ., Raleigh.
THE DENSITY OF EIGENVALUES IN THIN CIRCULAR CONICAL SHELLS
David K. Miller and Franklin D. Hart Washington NASA Mar.

1970 134 p refs
(Grant NGR-34-002-035)
(NASA-CR-1497) Avail: CFSTI CSCL 20K

A combined analytical and experimental study was made of the eigenvalue density and the cumulative number of eigenvalues of a thin circular conical shell. The investigation was directed toward the development of expressions that can be used easily in finding the eigenvalue density and number of eigenvalues of a conical shell which are applicable to a wide range of cone geometries, and which are valid over a frequency range sufficiently wide to be of engineering value. This is accomplished by applying wave number space integration techniques and numerical procedures to obtain expressions for the eigenvalue distribution function based on two separate frequency equations appropriate to thin conical shells. The expressions obtained are normalized with respect to cone geometry. The experimental arrangement used to determine the resonant frequencies is described, and the results of this investigation are presented in tabular and graphical form. The results of the analytical work are also presented along with the experimental data for easy comparison. Author

N70-22688# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
RANDOM RESPONSE OF PIECEWISE LINEAR SYSTEMS TO WHITE NOISE EXCITATION
H. Y. Yeh and J. T. P. Yao Sep. 1969 42 p refs
(Grant NSF GK-2865)
(PB-187298; CE-17(69)NSF-065) Avail: CFSTI CSCL 20K

A method of solution is developed for the computation of the transition probability of nth order piecewise linear systems subjected to white noise excitation. As an example, the mean-square displacement responses of a second order system are obtained. These results are also presented in a graphical form. The maximum mean-square responses of second order bilinear systems are found to increase with the parameter representing the point of stiffness discontinuity, delta. The maximum mean-square responses corresponding to the two segments of the system form the upper and lower bounds for the mean-square responses of the bilinear system. Author (USGRDR)

N70-22703 University of Southern Calif., Los Angeles.
AN EIGENVALUE STUDY OF AN EULER-BERNOULLI BEAM SUPPORTED AT TWO ARBITRARY POINTS
Eldon Lawrence Moulding (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-9035

A general solution is obtained for the eigenvalues of a uniform beam, hinged at two supports, as a function of the support locations along the beam. An Euler–Bernoulli formulation describing the motion of the beam during vibration was used in the analysis. The differential equation for the beam was solved by conventional methods and resulted in a general frequency equation for the beam. Examination of the eigenvalue curves reveal many characteristics common to all modes and are particularly apparent in the higher numbered modes. The support locations resulting in maximums and minimums were determined by consideration of the associated mode shapes of the beam. Equations are developed for computing support locations which result in maximum and minimum eigenvalues. In addition bounding values for the eigenvalues existing for each mode are derived. Approximate equations describing the eigenvalue functions for the higher numbered modes are given for symmetrically supported beams. Dissert. Abstr.

N70-22725 Lehigh Univ., Bethlehem, Pa.
RESIDUAL STRESSES IN A TWO-MATERIAL WEDGE AND A FINITE CYLINDER
Virgil Louis Hein (Ph.D. Thesis) 1968 205 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-7340

The method is applicable for plane strain or plane stress problems and treats the general case where each region is a wedge of arbitrary angle. The results are obtained by the use of the Mellin transform and the theory of residues. The method is applied to determine the stress singularity and the symmetric and skew-symmetric stress intensity factors resulting from the homogeneous temperature changes in bonded dissimilar materials. The results obtained from a comprehensive study of the characteristic equation show that the dominant effect is due to geometry and the secondary effect is caused by the choice of modulus and Poisson ratio. The corresponding axisymmetric problem, which is analogous to the case where one region is a quadrant and the second region is completely rigid, is also studied. Dissert. Abstr.

N70-22746 Iowa Univ., Iowa City.
BUCKLING OF CANTILEVERED BEAM-COLUMNS OF BI-SYMMETRIC I-SECTION
Gopal Jayaraman (Ph.D. Thesis) 1968 165 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-8752

Lateral instability of a uniform cantilevered I beam subjected to both axial (P2) and transverse (P1) forces at the free end is investigated. Equations of behavior derived through the use of energy theory are solved numerically by the shooting method to obtain all possible critical combinations of P1 and P2 to cause lateral buckling by the first mode. In addition, the interaction curve representing the infinite number of critical combinations of P1 and P2 is studied parametrically. The stabilizing effect of the tensile axial force upon the lateral buckling phenomena is also established. The analytical solutions obtained for the uniform cantilevered I beam are verified by experiment and the agreement of the experimental results with the analytical solutions is also presented. The lateral buckling of slightly tapered cantilevered I beams subjected to both P1, the transverse force, and P2, the axial force, and the interaction curves are obtained for various taperings by the shooting method is also considered. Dissert. Abstr.

N70-22758*# Alabama Univ., University. College of Engineering.
DYNAMIC ANALYSIS OF STABILITY AND DEPLOYMENT OF INFLATABLE SHELL STRUCTURES Final Report
E. Falgout E. Falgout and George E. Weeks Jan. 1970 103 p refs Revised
(Contract NAS8-21480)
(NASA-CR-102533; FR-110-58) Avail: CFSTI CSCL 20K

The primary structures analyzed were inflated cylindrical shells, considered the most feasible configuration for use as space vehicle antennas and gravity-gradient damper booms. The vibrational analysis of general pressurized cylindrical shells utilizing nonlinear membrane shell theory is presented. The free vibration of long cantilevered cylindrical beams is considered. The nonlinear analysis of an inflated cylindrical beam with undeformed axis inclined at acute angles relative to the vertical and rotated uniformly about the vertical is presented. Experiments were designed and performed to check the theory and analytical results obtained. A detailed discussion of these experiments is included. Author

N70-22771# Union Carbide Nuclear Co., Oak Ridge, Tenn. Oak Ridge Gaseous Diffusion Plant.
DAMPING IN A COMPOSITE BEAM MODEL
J. E. Corley 16 Dec. 1969 26 p ref
(Contract W-7405-eng-26)
(K-1773) Avail: CFSTI

The damping characteristics of a steel-concrete composite floor beam have been determined with the use of a scale model. The critical damping ratio, beta, at the first bending mode for this construction was found to be 0.0332 with a standard deviation of 0.00375. By loading the beam with lead bricks, a curve of the first bending frequency as a function of load was obtained and from this, using model predictive equations, a fundamental frequency for the prototype floor beam was estimated to be 11.6 Hz. A technique was developed which evaluates the parameters of natural frequency and damping ratio, using a nonlinear least squares curve fit routine of a transmissibility curve. Author (NSA)

N70-22783# Sandia Corp., Albuquerque, N.Mex.
SIGNIFICANCE OF STRAIN HARDENING AND STRAIN RATE EFFECTS ON THE TRANSIENT RESPONSE OF ELASTIC-PLASTIC SPHERICAL SHELLS
Thomas A. Duffey Sep. 1969 30 p refs Sponsored by AEC
(PB-187236; SC-RR-69-477) Avail: CFSTI CSCL 13M

Formulae describing the transient response of uniformly loaded thin spherical shells governed by elastic-plastic material laws are developed. It is shown that realistic values of material strain hardening and strain rate sensitivity (rate-dependent yield surface) have a significant effect on both dynamic and final shell deflections. The corresponding rigid-plastic solution is developed and compared to the elastic-plastic solution. Peak deflections are found to agree to within 20 percent for ratios of plastic-to-elastic energy greater than 3. A numerical solution of the corresponding problem with a strain-rate-dependent tangent modulus indicates that the static tangent modulus is generally sufficiently accurate for structural calculations. Author (NSA)

N70-22796# Northwestern Technological Inst., Evanston, Ill. Structural Mechanics Lab.
CRACK PROPAGATION GENERATED BY AN INCIDENT SHEAR WAVE
Jan. D. Achenbach Nov. 1969 39 p refs
(Contract Nonr-1228(34))
(AD-698849; TR-69-4) Avail: CFSTI CSCL 20/11

A plane horizontally polarized shear wave propagates into an undisturbed brittle elastic material containing a crack. The paper inquires into the conditions for initiation of crack propagation at a constant velocity upon diffraction of the incident wave by the crack. The investigation consists of two parts. In the first part the particle velocity and the shear stresses are determined for diffraction of a transient wave of arbitrary shape by a semi-infinite crack which extends at a constant speed once the wave front has impinged on the crack tip. In the second part of the investigation a power balance is employed to determine that shape of the incident pulse which is consistent with crack propagation at a constant velocity. It is shown that near the wave front the incident displacement wave must be of the form of a square root of the general argument t-ax-by. For this particular type of incident wave the instantaneous constant velocity of crack propagation is computed as a function of the angle of incidence, the amplitude of the incident wave, and of the material parameters. Curves are presented for the shear stress ahead of the crack tip. Author (TAB)

N70-22896# California Univ., Berkeley. Earthquake Engineering Research Center.
NONLINEAR SEISMIC RESPONSE OF EARTH STRUCTURES
Mostafa Dibaj and Joseph Penzien Jan. 1969 156 p refs Sponsored by Calif. Dept. of Water Resources
(PB-187904; EERC-69-2) Avail: CFSTI CSCL 13M

The primary objectives of the investigation presented here are (1) to examine the applicability of the theory of plasticity to the dynamic analysis of earth structures, including the selection of suitable yield criteria for soils (2) to develop a procedure for determining the inelastic response of earth structures, particularly earth dams, to earthquake excitations (3) to determine the effects and significance of using realistic nonlinear material properties in evaluating the dynamic response of earth structures (4) to establish the relative difference between rigid base motions and traveling wave motions (see section 6.4), (5) to interpret these results in terms of prototype behavior, and (6) to develop finite element computer programs. Author (USGRDR)

N70-22906*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STRUCTURAL DESIGN
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 18 p (See N70-22901 10-31)
Avail: CFSTI CSCL 22B

The structural design approach of the HEAO spacecraft is determined mainly by configuration constraints which result from considerations of the launch vehicle envelope, the location, size, and viewing requirements of the major experiments, and flat area requirements for fixed solar cell arrays. An additional constraint which affects the structural design approach is the requirement to locate the spacecraft center of gravity near the geometric center to minimize gravity gradient torques. The open truss assembly adopted for the spacecraft structure is described. Total payload weight and the weight of the six major experiments are analyzed and the payload adapter required for structural support of the spacecraft is described. R.B.

N70-22918*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ALTERNATE STRUCTURAL CONFIGURATION, APPENDIX E
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 9 p (See N70-22901 10-31)
Avail: CFSTI CSCL 22B

The baseline structural design was developed to minimize the disturbing gravity gradient torque by locating the spacecraft center of gravity near the geometric center. This constraint caused the primary load paths to become long, thereby decreasing the structural efficiency of the spacecraft. An alternate structural design is discussed which places the heavier experiments in the aft portion of the structure. The shortened load paths and reduced bending moments acting on the structure results in smaller member sizes, lower weight, and small deflections. The design for the alternate structural system is an open truss assembly similar to that of the baseline design. The cross section of the box truss is changed where necessary to accommodate the various experiments, particularly at the aft attach plane where the spacecraft structure will be attached to the adapter at eight attach points. The same advantages of flexibility and accessibility in the baseline configuration are also present in the alternate design. Author

N70-22969 Lehigh Univ., Bethlehem, Pa.
ON THE EQUATIONS FOR FINITE DEFLECTIONS OF THIN SHELLS OF REVOLUTION
Vahram Biricikoglu (Ph.D. Thesis) 1968 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-7326

The problem of radial stretching of a circular plate is considered in detail. A boundary layer technique is introduced to separate the governing equations into two groups. The interior solution (valid away from the edges) has been obtained using a method of direct numerical integration. The boundary layer analysis reveals the fact that the rapid change in thickness is confined to a narrow edge zone of order h and in the interior part of the plate the deformed thickness is still (approximately) constant, although it is not equal to the undeformed thickness. Numerical results are given for the Mooney material. The inflation of a shell of revolution subjected to internal pressure is also presented. The interior problem reduces to the membrane theory. The general problem for the shell of revolution is governed by an eight-order system of differential equations, which may be handled by the multisegment method of direct numerical integration. Dissert. Abstr.

N70-22989# Oak Ridge National Lab., Tenn.
MOTION OF ELASTO-PLASTIC MEMBRANES UNDER SHOCK LOADING
Lawrence Dresner 30 Oct. 1969 39 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2755) Avail: CFSTI

The motion of an infinitely long strip of foil with clamped edges was calculated under the following circumstances: pressure wave incident either head on or side on, and membrane stress either constant or proportional to strain. The constant-stress case was solved completely by the method of characteristics. The membrane profile and the maximum strain were known as a

function of the incident pressure, membrane thickness, membrane width, and membrane stress. A similarity solution is known for the membrane in which stress is proportional to strain for head-on incidence. It describes the early stages of membrane motion. It gives an acceptable approximation to the maximum strain as a function of incident pressure, membrane thickness, membrane width, and membrane modulus. Numerical solutions of the equations of membrane motion are described. Author (NSA)

N70-23005# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
MEASURING THE AXIAL RIGIDITY OF GYROMOTOR COLLARS [MESURE DE LA RIGIDITE AXIALE DES FLASQUES DE GYROSCOPES]
I. A. Baranov et al 1968 10 p ref Transl. into FRENCH from Russian Rept. In FRENCH and RUSSIAN
(LRBA-69-0726) Avail: CFSTI

Two methods of measuring the axial rigidity of gyromotor collars are considered: an existing one based on measuring the axial flexure of the collar due to the effect of axial loading, and a proposed method based on measuring the natural frequency of an oscillatory system which includes the collar as the flexible component. It is shown that the proposed method is ten times more accurate than the existing method. Transl. by R.B.

N70-23007# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
CALCULATING THE DISPLACEMENT OF THE CENTER OF A GYROSCOPE ROTOR IN THE CASE OF PURELY AXIAL LOAD AND PLIANT COVERS [CALCUL DU DEPLACEMENT DU CENTRE DU ROTOR D'UN GYROSCOPE DANS LE CAS DE CHARGE PUREMENT AXIALE ET DE FLECHISSEMENT DES FLASQUES]
M. P. Kovalev 1968 12 p refs Transl. into FRENCH from Russian Rept. In FRENCH and RUSSIAN
(LRBA-69-0727) Avail: CFSTI

A method is considered for calculating the displacement of the center of a gimbal in the case of finite rigidity of the gimbal support covers. Formulas are derived for calculating the displacement. Numerical analysis shows that use of pliant instead of absolutely rigid covers under similar conditions results in more uniform distribution of external loading between supports, an increase of rotor center displacement, and a decrease in critical loading. Transl. by R.B.

N70-23057# Boeing Co., Renton, Wash.
THE RELATIONSHIP BETWEEN TEST RESULTS AND SERVICE EXPERIENCE
D. E. Piper *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 12 p refs (See N70-23051 10-17)
(ARPA Order 878)
Avail: CFSTI

An attempt is made to correlate stress corrosion data generated on smooth and precracked specimens in sodium chloride solution with the safe-life and fail-safe concepts used to provide reliability in high performance structures. Data determined on smooth specimens indicate that the material will not fail by stress-corrosion cracking (or maybe initiate a stress-corrosion crack) below a threshold stress level (i.e. useful only in safe-life philosophy). Tests on full-scale are apparently more difficult to perform in stress corrosion than fatigue. It is suggested that the noticeable occurrence of stress corrosion in aluminum alloys in the short transverse grain direction has resulted in the designer tolerating surface treatments of components to offset poor stress-corrosion reisitance and provide structural reliability. Precracked specimen testing for stress corrosion cracking is relatively new compared with the conventional smooth specimen techniques. The use of both techniques offers an independent evaluation of initiation and propagation phenomena. It is proposed that specimen standardization will eliminate much of the argument between the materials engineer and the designer and provide an excellent line of communication between these disciplines. The materials engineer is now providing qualitative data on smooth specimens and quantitative results on precracked specimens. The designer should reciprocate by indicating whether the data are sufficient, what combinations of properties are required, and what trade-offs he is will to give for certain types of structural application. Author

N70-23059# Westland Helicopters, Ltd., Hayes (England).
RESIDUAL STRESSES ARISING FROM MACHINING AND FABRICATION
A. T. Bainbridge *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 23 p refs (See N70-23051 10-17)
Avail: CFSTI

A brief review is given of how residual stresses may be induced into the surface regions of some metallic materials by machining and fabrication operations. Processes considered include turning, milling, grinding, spark machining, bending, stretch forming, and welding. An indication is also given of the magnitude and sign of such stresses, which in certain instances can approach the yield strength of a material. Methods are outlined by which the magnitude of unfavorable residual tensile stresses may be controlled within safe limits or the stresses even completely eliminated, by careful attention to processing parameters, and by the use of subsequent thermal or mechanical stress relieving treatments. Author

N70-23061# United Kingdom Atomic Energy Authority, Harwell (England).
THE APPLICATION OF NDT TECHNIQUES TO THE PROBLEM OF STRESS CORROSION CRACKING
R. S. Sharpe *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 13 p (See N70-23051 10-17)
Avail: CFSTI

The areas are examined where improved nondestructive testing methods could assist in determining the susceptibility of components to stress corrosion, supporting laboratory investigations into the mechanism of stress corrosion, and monitoring the progression of cracking during the service life of components to replace the present practice of extrapolating from laboratory simulation tests. Emphasis is directed towards methods of residual stress measurement which seem closest to a practical test to replace the destructive stress relaxation methods currently used. Author

N70-23096 State Univ. of New York at Buffalo.
MOMENT PROPERTIES OF THE SOLUTION PROCESS FOR WEAKLY RANDOM LINEAR SYSTEMS AND THEIR STABILITY
Kuo-Kuang Chen (Ph.D. Thesis) 1969 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-20563

The analysis of a wide class of physical problems involves linear differential, integral, or integro-differential equations with weakly and randomly varying coefficients. These equations describe wave propagation in a random medium, dynamics of linear systems and structures with random imperfections, stability of systems with random parameters, and other problems where uncertainties in problem specifications necessitate the introduction of random coefficients. The moment properties of the solution process governed by equations of this type are considered. The emphasis is placed upon the mean and the covariance properties. Several possible representations for the mean and the corariance solutions are presented by means of a perturbation method. The moment stability of the solution process is then investigated, and criteria on the mean stability and the mean square stability are established. Finally, the theory developed here is applied to the investigation of problems in vibration and wave propagation. Dissert. Abstr.

N70-23102*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SIMULATION OF METEOROID-VELOCITY IMPACT BY USE OF DENSE PROJECTILES

Robert H. Morrison Washington Apr. 1970 34 p refs

(NASA-TN-D-5734; A-3315) Avail: CFSTI CSCL 20K

A technique is described for simulating the impacts of semi-infinite targets by low density, low fineness ratio cylinders at meteoroid velocities by impacting high density, low velocity projectiles. Conditions for simulation are stated and embodied in a model forming the basis of the technique. The feasibility of the technique is experimentally investigated by simulating the impacts of semi-infinite aluminum targets by polyethylene plastic cylinders of various low fineness ratios and the same velocity of 11.3 km/sec. The penetrations were simulated at lower velocities to within 10 percent by impacting aluminum, steel, nickel, and copper projectiles, but only to within 30 percent by impacting platinum projectiles. In application of the technique, the impacts of semi-infinite aluminum targets by cylinders of polyethylene and porous aluminum (0.44 g/cm(3)) at velocities of 15.2 and 22 km/sec, respectively, were simulated. Author

N70-23275# National Physical Lab., Teddington (England). Div. of Numerical and Applied Mathematics.

THERMAL STRESSES IN POLYGONAL PLATES

M. Maiti, G. F. Miller, and G. T. Symm Nov. 1969 14 p refs

(NPL-DNAM-83) Avail: CFSTI

The problem considered here concerns a thin homogeneous polygonal plate with its faces maintained at different uniform temperatures so that temperature varies linearly over its thickness. Two integral equation procedures are given for computing the twisting moments along the edge of such a plate. The behavior of the solution near a corner is investigated analytically. Numerical results are presented for three regular polygons. Author (ESRO)

N70-23375# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STUDIES ON THE THEORY OF STRUCTURES (COLLECTION OF ARTICLES)

A. G. Dorfman et al 18 Aug. 1969 297 p refs Transl. into ENGLISH from Issled. po Teorii Sooruzhenii (USSR), no. 15, 1965 p 1–266

(AD-698544; FTD-HT-23-939-68) Avail: CSFTI CSCL 13/13

The book is comprised of a series of articles devoted to problems of structural dynamics, the determination of critical velocities of moving loads, the vibrations of multistory frame buildings and the dynamic design of arches. Discussions are presented on the design of various structures for stability in the presence of linear and nonlinear couplings, within and beyond the elastic limit. Quantitative estimates of critical forces are provided. Author (TAB)

N70-23835 National Lending Library for Science and Technology, Boston Spa (England).

ANALYSIS OF A VERY LONG RING-REINFORCED CYLINDRICAL SHELL

J. A. Royak Sep. 1969 3 p refs Transl. into ENGLISH from Inzh. Zh. Mekh. Tverd. Tela, (USSR), no. 3, 1968 p 158–160

(NLL-LTI-746-314-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A solution is proposed to the problem of a circular cylindrical shell subjected to concentrated radial forces applied to the reinforcing ring. The radial displacement of the ring in contact cross section is determined. Formulas and a table are obtained permitting determination, with the help of the superimposition method, of radial displacements of the ring during the action on it of radial concentrated forces. Author

N70-23841# Brown Univ., Providence, R.I. Div. of Engineering.

PLASTIC WAVES OF COMBINED STRESSES DUE TO LONGITUDINAL IMPACT OF A PRE-TORQUED TUBE

J. Lipkin and R. J. Clifton Oct. 1969 87 p refs

(Contracts DAHC04-69-C-0027/1; N00014-67-A-0191-0003/6) (AD-698853; TR-1; TR-6) Avail: CFSTI CSCL 13/11

Experiments are reported in which annealed aluminum tubes are subjected to a static plastic torque followed by a longitudinal compressive impact. Measurements are made of both longitudinal and shear strain-time profiles at stations along the specimen. Qualitatively, the strain response at the gages corresponds to the arrival of a fast wave for which shear strain decreases while longitudinal strain increases followed by a slow wave for which both shear and longitudinal strains increase. A rate independent theory of combined longitudinal and torsional plastic wave propagation for workhardening materials is found to be adequate for predicting many features of the observed strain-time response in the specimens. For the particular case of an isotropic workhardening, elastic-plastic material, numerical solutions of the governing equations are compared with the results of the experiments. The same assumed material behavior is used for comparing observed behavior at unloading waves with theoretical predictions. Discrepancies are shown to be explainable in terms of the inadequacy of the assumption of strain-rate independent behavior. Author (TAB)

N70-23869# Technische Hochschule Stuttgart (West Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen.

CALCULATION OF AXISYMMETRIC SUPPORTING CONSTRUCTIONS UNDER AXISYMMETRIC AND SYMMETRIC LOADING AND TEMPERATURE DISTRIBUTION [DIE BERECHNUNG ACHSENSYMMETRISCHER UND NICHTSYMMETRISCHER BELASTUNG UND TEMPERATURVERTEILUNG]

J. H. Argyris and K. E. Buck 1969 29 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22–24 Sep. 1969 Avail: CFSTI

The matrix displacement method is applied to axisymmetric supporting bodies under certain conditions and some elements for the idealization of axisymmetric rigid bodies or thick-walled hollow bodies are described. In addition, fully compatible membrane shell elements are given, which are suitable along with the first named elements, for the idealization of supporting constructions in sandwich and also monocoque form. They can also be used (with zero-rigidity) for a simple systematic calculation of the kinematically equivalent model forces resulting from distributed compression loading. Examples such as torsion of a truncated cone, reinforced concrete reactor pressure vessels and the ground plate of a converter vessel are discussed. ESRO

N70-23881# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

GRID CUPOLAS AS RADOMES [NETZKUPPELN ALS RADOME]

W. Schoenbach Dec. 1969 46 p refs Transl. into ENGLISH from Stahlbau (W. Berlin), v. 38, no. 2, 1969 p 33–43 In ENGLISH and GERMAN Prepared for Lincoln Lab., MIT

(AZT-69-639-GELL) Avail: CFSTI

Dimensional and design problems involved in the construction of air-supported or rigid radomes are viewed as networks of diversified geometry. Calculation of the framework by computer program is discussed, using the example of a radome with a spherical diameter of 49 meters, and the advantages of using steel versus aluminum for the framework are assessed. Author

N70-23709# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).

RESIDUAL STRENGTH OF CRACKED STIFFENED PANELS

H. Vlieger and D. Broek Dec. 1967 50 p refs Sponsored by Neth. Aircraft Develop. Board

(NLR-TN-S-653) Avail: CFSTI

A brief review is given of the literature dealing with the effect of a stiffener on the stress distribution in a cracked sheet.

Existing theories for the prediction of the residual static strength of cracked stiffened panels are analyzed. A new approach to this problem is developed, using the residual strength characteristics of the unstiffened panel. Results are given of residual strength tests carried out on panels with two simple strap stiffeners to check the validity of the proposed method. Author (ESRO)

N70-23767# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE INFLUENCE OF INITIAL PERTURBATIONS ON THE STABILITY OF SMOOTH CYLINDRICAL SHELLS
R. E. Geizenblazen et al [1969] 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Tverd. Tela (USSR), no. 6, 1969 p 119–122
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

An experimental method is proposed for isolating the effect of the main perturbing factors on the critical loads of a shell under axial compression. Perturbing factors of initial deflection and deviation of endfaces from a plane recorded for fifty specimens are compared with theoretical calculations. Equations are derived for theoretical solution of the stability of a shell with non-axisymmetric deflection. R.B.

N70-23764# Nationaal Luchten Ruimtevaartlaboratorium, Amsterdam (Netherlands).
THE STATIC STRENGTH OF ALUMINUM ALLOY SHEET SPECIMENS CONTAINING ONE OR MORE TRANSVERSE ROWS OF CIRCULAR HOLES
H. Vlieger Dec. 1968 39 p refs Sponsored by Neth. Aircraft Develop. Board
(NLR-TR-69016-U) Avail: CFSTI

Static tests were carried out on aluminum alloy sheet specimens with one or more rows of circular holes and a rectangular or a staggered hole pattern to investigate the effect of the circular holes on the static tensile strength. The static efficiency is defined as the ratio of the net section fracture stress of the notched specimen and the tensile strength of the unnotched material. Considering the sheet specimens as a series of parallel strips of width equal to the hole spacing, each containing one central hole, the static efficiency of the sheet specimens appears to be equal to or larger than that of the strip. The increase of static efficiency depends on the number of holes, that is on the number of parallel elements, and on the ratio of hole diameter and hole spacing. The static efficiency of specimens with a staggered hole pattern appears to be somewhat lower than that of specimens with a rectangular array and similar values of hole spacing and row distance. Author (ESRO)

N70-23799# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeuebau.
CALCULATION OF THIN-WALLED, ROTATIONALLY SYMMETRIC, FILAMENT WOUND INTERNAL PRESSURE VESSELS BY THE MEMBRANE ANALYSIS. PART 1: NETTING THEORY [BERECHNUNG DUENNWANDIGER, ROTATIONSSYMMETRISCHER, FADENGEWICKELTER INNENDRUCKBEHAELTER MACH DER MEMBRANTHEORIE. TEIL 1: NETZTHEORIE]
Rolf Zimmermann Oct. 1969 101 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-83) Avail: CFSTI

The application of netting theory to the design of filament would internal pressure vessels consisting of single-layer domes and a two-layer cylinder is demonstrated. Following the existing literature, geodetically and in-plane wound vessels are considered. It is shown that the conditions of equilibrium are satisfied in the strict sense of the netting theory only for geodetically wound vessels, whereas inplane wound vessels necessitate power transmission by the matrix. Differential equations for the calculation of contours, masses and volumes of the domes are derived and evaluated. The contour calculation of geodetically wound domes is reduced to the application of tabulated elliptic integrals of Legendre type. Data for dimensioning the shells and for the evaluation of masses, volumes and interesting geometric values of vessels are summarized. As an application an example demonstrates the design of a combustion chamber of a solid propellant engine. Author (ESRO)

N70-23819# Westland Aircraft, Ltd., Yeovil (England). Westland Helicopters, Ltd.
STUDY OF STATIC AND FATIGUE PROPERTIES OF AN AIRCRAFT CASTING (18 PER CENT Ni MARAGING STEEL)
B. Singh London Min. of Technol. [1968] 52 p refs
(Contract KS/1/0420/C.B.43(a)1)
(D-MAT-160) Avail: CFSTI

Tests on aircraft wing root end fittings with integrally cast clover leaf test bars made in 18% Ni maraging steel by the ceramic shell moulds process have demonstrated that it is practicable to produce castings with asymmetric casting geometry having tensile strength of 110-115 tonf/ sq inch with adequate ductility and impact resistance. Both the static mechanical properties and fatigue strength are marginally influenced by the cooling rate during solidification. Whilst the static strength for the steel castings in 18% Ni maraging steel can be increased from 80 tonf/sq in TS to 100 + tonf/sq in TS, the fatigue strength is reduced, following the reduction previously noted with 80 tonf/sq in TS steel as compared with 64 tonf/sq in TS steel. However, where the maximum fatigue strength is not the predominant criterion, the designer can usefully take advantage of the increase of 20 + tonf/sq in TS with adequate ductility. Author (ESRO)

N70-23871# Messerschmitt-Boelkow G.m.b.H., Munich (West Germany).
PECULIARITIES OF THE HBF TUBE DESIGN WITH REFERENCE TO STRENGTH, FABRICATION AND APPLICATION [BESONDERHEITEN DER HFB-TUBUSBAUWEISE HINSICHTLICH DER FESTIGKEITEN, DER VERARBEITUNG UND DER ANWENDUNG]
R. Feddersen 1969 15 p In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

A tabular sandwich construction material consisting of cellulose acetate tubes bonded hexagonally, is described which can be used in aircraft and naval construction. Possible ways of plastically deforming the material to obtain special shapes are outlined and some applications are mentioned, e.g. aircraft floors, wing sections, maintenance accession doors. ESRO

N70-23872# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany). Abteilung fuer Werkstoffe und Verfahrenstechnik.
STRUCTURAL DESIGN AND MODERN MATERIALS TECHNOLOGY IN AERONAUTICS AND ASTRONAUTICS. [BEISPIELE ZU BAUWEISEN DER MODERNEN WERKSTOFFTECHNOLOGIE AUS DER LUFT- UND RAUMFAHRTENTWICKLUNG]
Helmut Nussbaum 1969 31 p In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

Examples of the use of titanium alloys, high strength steels and plastic materials in aerospace technology are described. In addition, production problems relating to lectron beam welding, explosive forming, hot forming, and bonding are discussed. Quality control procedures, e.g. long-term strength tests on titanium screws, notched and welded titanium samples, creep tests on aluminum alloys and stress corrosion tests of titanium are described. The influence of aging on laminates is also outlined. ESRO

N70-23878# Hamburger Flugzeugbau G.m.b.H. (West Germany).
RESULTS AND EXPERIENCE GAINED FROM A FLUTTER INVESTIGATION OF A DYNAMICALLY SIMILAR T TAIL

ASSEMBLY [ERGEBNISSE UND ERFAHRUNGEN EINER FLATTER-UNTERSUCHUNG AN EINEM DYNAMISCH EHNLICHEN T-LEITWERKSMODELL]
H. Zimmermann and E. Achenbach 1969 31 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

The design, building, and testing of a 1:6 wind tunnel scale model of a T tail assembly is described. The measuring methods both dynamic and static – and the evaluation of the spectral power density are also described. The evaluation illustrates the advantages of a statistical approach to these problems. ESRO

N70-23880# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany)
REVIEW OF INVESTIGATIONS ON AERONAUTICAL FATIGUE IN THE FEDERAL REPUBLIC OF GERMANY, APRIL 1967 – MARCH 1969
E. Gassner and O. Buxbaum 1969 90 p refs Presented at the 11th Conf. of the Intern. Comm. on Aeron. Fatigue, Stockholm, May 1969
(LBF-S-81) Avail: CFSTI

This report consists of the following material: Investigations by the Laboratorium für Betriebsfestigkeit (cumulative frequency distributions of the acceleration of a fighter aircraft and of bending moments on the tailplane of a transport aircraft; comparative tests on specimens with internal and external notches; flight-by-flight tests etc.). Investigations of other German research institutes (comparison of program loading with digital random loading; cyclic stress-strain behavior; strain concentration factor). Investigations of German aircraft manufacturers (fatigue life estimation of aluminum alloy lugs with interference fit bushes; welded joints of Nimonic 80A and Ti/5Al/2.5 Sn; single-shear riveted joints). Author (ESRO)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N70-22548# ARO, Inc., Arnold Air Force Station, Tenn.
MANUAL OF BOILING HEAT-TRANSFER DESIGN CORRELATIONS Final Report
W. Frost (Tennessee Univ.) and G. S. Dzakowic AEDC Dec. 1969 75 p refs
(Contract F40600-69-C-0001)
(AD-698323; AEDC-TR-69-106) Avail: CFSTI CSCL 20/13

Selected boiling heat-transfer correlations currently being used for design purposes are presented in a graphical form which enables the engineer to compute numerical values of the boiling heat flux parameters rapidly and without knowledge of the physical properties of the fluid other than at one arbitrary reference state. Author (TAB)

N70-22565# Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. Pantex Plant.
THIN-LAYER PETN: PREPARATION AND INITIATION BY EXPLODING FOIL
J. D. Harrell and J. L. Christensen Dec. 1968 28 p refs
(Contract DA-11-173-AMC-487(A))
(PB-187899; MHSMP-5) Avail: CFSTI CSCL 19A

A method has been developed for producing thin layers of PETN on metal foils. It is a slurry coating technique using a nitrocellulose binder. Experiments for exploding several square inches of foil (to produce imitation of PETN layer) by a capacitor bank indicated thin aluminum on Mylar was near optimum. Foil explosion took place when the 15 microfarad bank was charged to 4 kV. Explosion of the PETN layer (simultaneous, within a microsecond) occurred on such foils when the capacity bank was charged to about 16 kV or more. Author (USGRDR)

N70-22603 Georgia Inst. of Tech., Atlanta.
TRANSIENT FILM BOILING ON A HORIZONTAL CYLINDRICAL SURFACE IN A SUBCOOLED LIQUID
Howard Hong-Yuang Yen (Ph.D. Thesis) 1969 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-4516

An analytical and experimental investigation was made to determine the transient film growth during the initial regimes of transient film boiling from a horizontal wire in subcooled liquid with various degrees of subcooling. An analytical analysis, using the continuity, momentum, and energy equations, gives a solution for the local temperature distribution in the subcooled liquid phase; in addition, the law of the phase change front is obtained from this analysis. Incompressible, radial flow is assumed. The solution to the energy equation gives the temperature distribution as a function of the incomplete gamma function associated with the phase growth constant of proportionality as an argument. Constant heat flux from the heat source is assumed in the vapor phase analysis. Dissert. Abstr.

N70-22619 Texas A&M Univ., College Station.
AN EXPERIMENTAL INVESTIGATION OF BOILING BURNOUT FOR SUBCOOLED CARBON TETRACHLORIDE UNDER CONDITIONS OF CONSTRAINED VAPOR SPACE VOLUME
Jack Allen Lock (Ph.D. Thesis) 1968 66 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-8489

It has been determined that boiling heat flux densities may be made to exceed maximum pool boiling values for the same pressure and subcooling. Heat flux density elevations of about 50% were measured, and larger values may be possible. Large fluctuations in the vapor space volume were eliminated by placing a small, rigid enclosure around the boiling surface and regulating the amount of fluid inside the enclosure. The use of a small enclosure system allows vapor volume to be controlled. In the current experiments, the degree of control was limited to holding the vapor volume relatively constant (at an unknown value) with respect to rapid fluctuations. Dissert. Abstr.

N70-22718 Polytechnic Inst. of Brooklyn, N.Y.
NONLINEAR COMBUSTION INSTABILITY: LONGITUDINAL MODE
Stanley Philip Goldstein (Ph.D. Thesis) 1969 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-20335

An analytical model describing longitudinal wave propagation in a combustion chamber is developed. Based on the assumptions of one dimensional flow, with vaporization as the rate controlling process in combustion, augmented conservation equations are derived. In these equations the droplets act as sources of mass, momentum and energy to the gas flow field. The derived equations are then solved by a Lax-Wendroff two step finite difference method. A new droplet vaporization model is described in which the conductivity of the drop is finite. Computer studies of this model indicate that energy coupling between waves during periods of combustion instability is the result of the superheating of the drops and the subsequent flux of mass is delayed by a period which is proportional to the decay time of the pressure pulse. These models are applied to the case of a single finite pressure pulse propagating through the combustion chamber of a rocket engine. For the thermodynamic and geometric parameters chosen it is shown that the wave attenuates and leaves in its wake a series of wavelets. Dissert. Abstr.

N70-22778# Politecnico di Torino (Italy). Ist. di Macchine e Motori per Aeromobili.
CALCULATING THE FUNCTIONAL STABILITY LIMITS FOR GAS TURBINES [SUL CALCOLO DEL LIMITE DI STABILITA' DI FUNZIONAMENTO DELLE TURBINE A GAS]
Alberto Beccari and Leonello Verduzio Dec. 1968 31 p refs In ITALIAN; ENGLISH summary *Its* Publ. No. 109
Avail: CFSTI

The purpose of this study is to investigate the detailed phenomena occurring inside the combustion chamber of gas turbine which have an influence on the stability limits of the power plant with respect to pressure oscillations. Using the small perturbations method the stability limits of the same hypothetical gas turbine are determined in two cases, namely; assuming that the details of the combustion process have no influence on the behaviour of the machine, and using such details in an analysis based on that used by Crocco and Cheng for rocket combustors. The results show that the combustion chamber behaviour has a very significant influence on the stability limits. Author

N70-22795# California Univ., Berkeley. College of Engineering.
WAVE DYNAMIC STUDIES Scientific Report, 1 Oct. 1968–30 Sep. 1969
A. K. Oppenheim Sep. 1969 9 p refs
(Grant AF-AFOSR-129-67)
(AD-698851; AFOSR-69-3053TR) Avail: CFSTI CSCL 21/2

A study was made of gas-wave-dynamic phenomena during the transient state from combustion initiation to stable detonation. The results should provide basic information on the generation of pressure waves by explosive reactions, important to the understanding of combustion instability in rocket chambers and similar devices, as, for instance, supersonic combustion propulsion systems for hypersonic flight vehicles. Author (TAB)

N70-22868*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLID PROPELLANT ENGINEERING
In its Space Program Sum. No. 37-59, Vol. 3, 31 Oct. 1969 p 183–191 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 21B

A simultaneous streak and framing camera is used to determine high-rate combustion phenomena occurring in solid propellants and electro-explosive devices. Pressure distance measurements are performed from a detonator, a squib, and an electric match. Sheet and overhead atomizer injectors were used for water quenching tests of solid propellant rockets; motion picture data of the process show quenching the combustion to be coincident with advancement of the water interface over the propellant surface. High speed motion photography of T-burner firings seem to indicate that the burner can provide data pertinent to the problem of combustion instability in rocket chambers. G.G.

N70-22919*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THERMAL ANALYSIS, APPENDIX F
In its Conceptual Design of a High Energy Astronomy Obs. 16 Feb. 1970 29 p (See N70-22901 10-31)
Avail: CFSTI CSCL 20M

Six different thermal models were analyzed with the vehicle in different orientations with respect to the sun. Various configurations are considered for transferring heat from the solar panels to the panels on the opposite side of the vehicle. Two of the six configurations were selected for further study. R.B.

N70-22982# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT AND MASS TRANSFER, VOLUME 7, PART 1, 1968
A. V. Lykova et al 20 Aug. 1969 256 p refs Transl. into ENGLISH from the Russian Report
(AD-698517; FTD-HT-23-820-68-Pt-1-Vol-7) Avail: CFSTI CSCL 20/13

Papers of the All-Union Conference on Heat and Mass Transfer (May 1968, Minsk), are presented. An examination is made of analytical and experimental methods of determining thermophysical properties of compounds, instruments and equipment are described, and results of research on thermal conductivity and on the temperature coefficient of thermal conductivity, heat capacity, thermal diffusion, enthalpy, and viscosity of various systems (solid, liquid, gaseous) are also presented. Part 1 is entitled: Analysis of thermophysical and transport properties of compounds. TAB

N70-22983# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT AND MASS TRANSFER, VOLUME 7, PART 2, 1968
A. V. Lykova et al 20 Aug. 1969 322 p refs Transl. into ENGLISH from the Russian Report
(AD-698518; FTD-HT-23-820-68-Pt-2-Vol-7) Avail: CFSTI CSCL 20/13

Papers of the All-Union Conference on Heat and Mass Transfer (May 1968, Minsk), are presented. Part 2 is entitled: Methods and instruments for determining parameters of heat and mass transfer. TAB

N70-22984# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT AND MASS TRANSFER, VOLUME 7, PART 3, 1968
A. V. Lykova et al 20 Aug. 1969 192 p refs Transl. into ENGLISH from the Russian Report
(AD-698519; FTD-HT-23-820-68-Pt-3-Vol-7) Avail: CFSTI CSCL 20/13

Papers of the All-Union Conference on Heat and Mass Transfer (May 1968, Minsk), are presented in this book. Part 3 is entitled: Heat and Mass Transfer Parameters. TAB

N70-22992 Syracuse Univ., N.Y.
INVESTIGATION OF THE DIFFUSION OF A SCALAR IN TURBULENT SHEAR FLOW
Vitold Raimond Kruka (Ph.D. Thesis) 1968 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-7754

The results of the diffusion of temperature, a scalar, in the turbulent shear flow of a pipe are presented. The pertinent mean and statistical temperature and velocities were measured, some temperature-velocity correlations occurring in the energy and the so called temperature-fluctuation-production equations were measured where the instrumentation permitted, others were evaluated with the aid of isotropic relations. Triple correlations of the fluctuating parameters were measured by a new technique. The turbulent heat transport term is dissimilar in the pipe and boundary layer flow. The assertion is supported by measurement and theory. Similarity between momentum and temperature diffusion is exhibited by a law-of-the-wall. Near the wall, a peculiar behavior of the molecular diffusion term, found in the temperature-fluctuation-production equation, is presented and shown to exist in other cases as well. Dissert. Abstr.

N70-23016 Tulane Univ., New Orleans, La.
UNSTEADY STATE SIMULATION AND CONTROL STUDY OF A COUNTERFLOW DISTRIBUTED PARAMETER SYSTEM: THE DOUBLE-PIPE HEAT EXCHANGER
Lawrence Varnum Anthony Beckman (Ph.D. Thesis) 1969 182 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-20458

Finite difference methods are utilized in numerically simulating a distributed exchanger model which includes the effects of axial dispersion. An experimental study was conducted using an operational double-pipe, countercurrent exchanger. Transient response data were obtained by pulse testing the experimental system. Excellent agreement of these experimental results with corresponding simulation response data substantiates the fidelity of the distributed models. An expression is derived for estimating the turbulent

thermal dispersion coefficient considering a substantial radial heat flux. The coefficient calculated from this expression is in good agreement with the value obtained by matching the experimental and simulation results. Feedback control of the double-pipe exchanger was digitally simulated. Conventional controller tuning methods proved inadequate in effecting satisfactory feedback control of this distributed parameter system. Dissert. Abstr.

N70-23093 Yale Univ., New Haven, Conn.
STABILITY AND CONVECTION OF A THERMALLY DESTABLIZED LAYER OF FLUID ABOVE A STABILIZED REGION
John Andrews Whitehead, Jr. (Ph.D. Thesis) 1968 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-8612

The stability and finite amplitude motion of a thin thermally destabilized layer of fluid, bounded above by a flat surface and below by a deep stabilized fluid, are investigated. Results of linear stability calculations are reported for a variety of simple representative temperature distributions subject ot various boundary conditions. Experimental observations of a destabilized layer above a stabilized region of liquid are given. Dissert. Abstr.

N70-23156*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL CAVITATION AND FLASHING OF POTASSIUM FLOWING ADIABATICALLY THROUGH A VENTURI SIZED AS A BOILER INLET
Orlando A. Gutierrez and David B. Fenn Washington Apr. 1970 72 p refs
(NASA-TN-D-5738; E-5346) Avail: CFSTI CSCL 20M

Subcooled liquid potassium was flashed adiabatically in a 0.1015-in throat-diameter venturi. Data were obtained before, during, and after flashing at flow rates from 300 to 660 lbm/hr and temperatures from 1140 to 1460 F. Flow rate after flashing depended only on inlet pressure and temperature. Liquid tensions/superheats were obtained prior to incipient flashing, with some pressures falling below absolute zero. Maximum liquid tensions were correlated by a force-balance equation for vapor bubbles with radii between 0.0001 and 0.00005 in. Incipiency data are compared with non-adiabatic data for potassium in the literature. Author

N70-23198*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CORRELATION OF CRITICAL HEAT FLUX FOR WETTING FLUIDS AND CHANNELS OF VARIOUS CROSS SECTIONS
Uwe H. von Glahn [1969] 13 p refs
(NASA-TM-X-52656) Avail: CFSTI CSCL 20M

An empirical correlation for predicting critical boiling heat flux (burnout condition) under conditions of stable flow for wetting fluids is presented. The correlation includes data for water, nitrogen, hydrogen, and potassium. Flow passage geometries considered include ciruclar tubes, annular tubes, and rectangular channels. The effect of swirl devices on critical heat flux is discussed and an acceleration correlation parameter is included. All fluid property terms are evaluated at the fluid saturation temperature associated with the burnout condition. Author

N70-23203*# National Aeronatuics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ON THE EFFECT OF HELICAL-FLOW INSERTS ON BOILING PRESSURE DROP
James R. Stone [1969] 10 p refs
(NASA-TM-X-52660) Avail: CFSTI CSCL 20M

The effect of helical-flow-promoting inserts on boiling pressure drop is correlated for water and alkali metals at relatively low pressures. A constant-slip model is used. The slip ratio (mean gas velocity divided by mean liquid velocity) is approximated by the square root of the liquid-to-gas density ratio. For boilers with no inserts, the two-phase friction factor has previously been correlated as a function of mean superficial liquid and gas Reynolds numbers. It is assumed that inserts affect pressure drop through an increase in friction factor and reduction in flow area. The two-phase friction factor is correlated herein as a function of mean superficial liquid and gas Reynolds numbers and the ratio of insert pitch to tube diameter. Author

N70-23211*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL STUDY OF FREEZING AND MELTING OF FLOWING WARM WATER AT A STAGNATION POINT ON A COLD PLATE Technical Paper
Joseph M. Savino, John F. Zumdieck, and Robert Siegel 1970 10 p refs to be presented at the 4th Intern. Heat Transfer Conf., Versailles/Paris, 31 Aug.–5 Sep. 1970
(NASA-TM-X-52650) Avail: CFSTI CSCL 20M

A jet of warm water was directed against a cold surface producing in the vicinity of the stagnation point a uniform convective heat transfer coefficient. By providing transient cooling of the surface, a layer of ice could be made to form on it or an existing layer to melt. The ice thickness variation with time was measured and compared well with a transient analysis carried out for a convective boundary condition at the solid-liquid interface. The convective heat transfer coefficient was determined experimentally at steady state conditions. The analysis predicted the transient solidification adequately for engineering applications. Author

N70-23219 Pittsburgh Univ. Pa.
BUBBLE DYNAMICS IN A VERTICALLY VIBRATING FIELD AND THEIR EFFECT ON POOL BOILING HEAT TRANSFER
G. Martin Fuls (Ph.D. Thesis) 1968 257 p
Avail: Univ. Microfilms: HC $11.70/Microfilm $3.25 Order No. 69-6397

A theoretical criterion was developed for stabilizing vapor bubbles in the vicinity of a heating element and to experimentally determine the effect of bubble stabilization on heat transfer rate in pool boiling. A mathematical model is developed for a single, small gas bubble in an otherwise homogeneous, vertically vibrating liquid column. The differential equation of motion of the liquid column is shown to be the one dimensional wave equation. The corresponding equation for the theoretical speed of sound necessary for the valuation of the wave equation is developed. The effects on the speed of sound of the elastic rectangular tank and homogeneous distribution of vapor are included. The differential equations of motion of the bubble are developed and include consideration of virtual mass in both pulsation and translation, weight of the gas in the bubble, proximity of the oscillating frequency to the natural frequency of the bubble, viscous drag in translation and surface tension effects at the bubble-liquid interface. Dissert. Abstr.

N70-23224*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AUGMENTATION OF SINGLE-PHASE HEAT TRANSFER IN TUBES BY USE OF HELICAL VANE INSERTS
Martin U. Gutstein, George L. Converse (GE, Cincinnati, Ohio), and Jerry R. Peterson (GE, Cincinnati, Ohio) [1969] 13 p refs
(NASA-TM-X-52665) Avail: CFSTI CSCL 20M

The pressure drops and heat transfer coefficients of helical vane inserts of four different pitch-tube diameter ratios were measured over a Reynolds number range of about 30,000 to 300,000. The heat transfer coefficients and the pressure drops increased with increasing mass flow rate and decreasing insert pitch-tube diameter ratio. A momentum analysis, based on solid body rotation, resulted in new expressions for the momentum and frictional pressure drops for fully-developed flow in these inserts. Helical vane friction factors and Stanton numbers, computed from the experimental data in accordance with parameters derived from the analysis, correlated with conventional plain tube expressions. Author

N70-23228*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN INVESTIGATION OF GRAVITY EFFECTS ON LAMINAR GAS JET DIFFUSION FLAMES
Thomas H. Cochran and William J. Masica [1970] 24 p refs Proposed for presentation at 13th Intern. Symp. on Combust., Salt Lake City, 23-29 Aug. 1970; sponsored by The Combust. Inst.
(NASA-TM-X-52757) Avail: CFSTI CSCL 20M

An experimental program was conducted to study the burning of laminar gas jet diffusion flames in a zero gravity environment. The tests were conducted in the 2.2 second zero-gravity facility. The photographic results indicate that a sudden decrease in gravity level from one to zero effected an immediate reduction in the length of the flame. Continued time in zero gravity resulted in the flame expanding away from the burner. For lower Reynolds number fuel flows, the flames increased in size until they appeared to be extinguished while for high Reynolds number fuel flows they established a steady state zero-gravity configuration. Author

N70-23259*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A CORRELATION OF SUBCOOLED-BOILING PRESSURE DROP FOR LOW-PRESSURE WATER FLOWING IN TUBES WITH CONSTANT HEAT FLUX
James R. Stone [1969] 15 p refs
(NASA-TM-X-52736) Avail: CFSTI CSCL 20M

A one-dimensional-flow model is developed which relates the pressure drop for subcooled boiling inside straight, circular tubes with constant heat flux to parameters generally known and one unknown variable, the net fraction of heat added to the fluid which goes into vaporization. The basic equations of change are applied to a differential control volume. It is assumed that a modified single-phase friction factor may be used. Thus, an equation for the local pressure gradient is obtained, dependent only on known quantities and the vaporization rate parameter. This equation is then integrated for constant heat flux, physical properties, and vaporization rate parameter. The overall pressure drop is thus obtained as a function of known quantities and the effective mean value of the vaporization rate parameter. The method of correlation is to determine mean values of this vaporization rate parameter from experimental pressure drop data and then correlate this parameter as a function of test variables. Author

N70-23262 Texas A & M Univ. College Station.
A SOLUTION TO THE INTEGRAL EQUATIONS FOR RADIATIVE TRANSFER OF HEAT IN THE ATMOSPHERE
Robert Donald Boudreau (Ph.D. Thesis) 1968 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-8467

It is assumed that the upward radiation from the underlying earth can be treated as blackbody radiation. The transmissivity of the atmosphere is taken to be given by a sum of exponentials which are functions of the precipitable depth of water vapor, the major radiating gas in the atmosphere. Specifying an exponential form for atmospheric transmissivity permits the integration of the transfer equations, provided that the vertical distribution of the fourth power of temperature, T4, is expressed as a polynomial function of precipitable water, w. Hence, the problem of radiative transfer of heat is reduced to the problem of polynomial approximation. In order to obtain analytic solutions to the flux equations and the equations for radiative temperature change, the diffusivity approximation is used. The value of the diffusivity factor which introduces thd least error in the diffusivity approximation was determined by numerical integration to be close to 1.6. Dissert. Abstr.

N70-23284*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONFORMAL MAPPING PROCEDURE FOR TRANSIENT AND STEADY-STATE TWO-DIMENSIONAL SOLIDIFICATION
R. Siegel, M. E. Goldstein, and J. M. Savino [1969] 13 p
(NASA-TM-X-52653) Avail: CFSTI CSCL 20M

A conformal mapping method was developed for analyzing two-dimensional transient and steady-state solidification problems. The method was applied to the solidification which takes place on a cold plate of finite width immersed in a flowing liquid and to the solidification inside of a cooled rectangular channel which contains a warm flowing liquid. The transient and steady-state shapes of the frozen regions are investigated. Author

N70-23399*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BEHAVIOR OF A VAPOR BUBBLE IN A PULSATING PRESSURE FIELD
Y. Y. Hsu and R. G. Watts [1970] 14 p refs Proposed for presentation at 4th Intern. Heat Transfer Conf., Versailles, France, 31 Aug.–5 Sep. 1970
(NASA-TM-X-52655) Avail: CFSTI CSCL 20M

The response of a vapor-gas bubble to a sinusoidal pressure pulsation is analyzed. The cases of a spherical bubble in an infinite body of liquid and a truncated spherical bubble attached to a wall are examined. The interior of the bubble is assumed to be a mixture of saturated vapor and noncondensable gas. The frequency response function is obtained and includes the effects of frequency, bubble size, and liquid subcooling. Experimental results of bubbles in water and on metal surfaces are compared with the analysis. Author

N70-23409*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HEAT TRANSFER IN A CHANNEL WITH RANDOM VARIATIONS IN FLUID VELOCITY
Morris Perlmutter [1969] 15 p refs
(NASA-TM-X-52649) Avail: CFSTI CSCL 20M

Heat transfer results have been obtained for randomly varying laminar flow in a heated parallel plate channel. Two types of heat transfer boundary conditions are considered: (1) The channel walls are at constant temperature; or (2) a specified uniform heat flux is transferred at the walls. The heat transfer behavior is obtained along the entire length of the channel. The temperature distributions are two-dimensional but a slug flow velocity profile is assumed. The results show significantly higher mean wall temperatures and, for short channels, lower wall heat fluxes when compared to the steady flow cases. Author

N70-23411# Fraunhofer Institut, Freiburg (West Germany).
ABSOLUTE MEASUREMENT OF THERMAL CONDUCTIVITY OF ARGON IN A SHOCK TUBE [ABSOLUTMESSUNG DER WAERMELEITFAEHIGKEIT VON ARGON IM STOSSROHR]
Rainer Ewald 1969 71 p refs In GERMAN
(Rept-10-69) Avail: CFSTI

Numerical values for the thermal conductivity of argon at temperatures of about 5000 5000 K were measured for the first time. A differential equation, involving the thermal conductivity was derived from the basic equations for the compressible temperature boundary layer forming at the end of a shock tube after reflection of the shock, and interference photographs of the temperature boundary layer aided the solution of the equation. A Mach-Zehnder interferometer was used for investigating the layer along with a pulsed ruby laser and a rotating mirror camera. These devices can also be used for investigating other rare gases. ESRO

N70-23452*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUMMARY OF VARIABLE PROPERTY HEAT-TRANSFER EQUATIONS AND THEIR APPLICABILITY TO A NUCLEAR ROCKET NOZZLE
Maynard F. Taylor [1969] 6 p refs
(NASA-TM-X-52648) Avail: CFSTI CSCL 20M

The prediction equation resulting from a thorough study

of all available single-phase hydrogen heat-transfer data is modified to predict heat-transfer coefficients on both the concave and convex surface of curved tubes. The prediction equations for straight and curved tubes are then applied to the Phoebus-2 nuclear rocket nozzle. Predicted exit pressure and temperatures are compared with experimental values from recent nuclear tests of the Phoebus-2 nozzle, and found to be in very good agreement. Author

N70-23453*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIMILARITY AND CURVATURE EFFECTS IN POOL FILM BOILING
Robert C. Hendricks and Kenneth J. Baumeister [1969] 13 p refs
(NASA-TM-X-52652) Avail: CFSTI CSCL 20M

Cooldown film boiling heat transfer data from small diameter spheres (0.0397 to 1.27 cm) are presented, and the effects of curvature and similarities of the theoretical analyses for the flat plate, cylinder, and sphere are assessed. The data are in good agreement with theory but are significantly higher than predicted from the classic Bromley equation. Author

N70-23548# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYTICAL CHEMICAL KINETIC STUDY OF THE EFFECT OF CARBON DIOXIDE AND WATER VAPOR ON HYDROGEN-AIR CONSTANT-PRESSURE COMBUSTION
Wayne D. Erickson and George F. Klick Washington Apr. 1970 40 p refs
(NASA-TN-D-5768; L-6959) Avail: CFSTI CSCL 21B

Numerical solutions have been obtained for the finite-rate constant-pressure combustion of stoichiometric hydrogen-air mixtures in the presence of small to moderate amounts of carbon dioxide CO2 and water vapor H2O. Computations have been carried out for initial mixture temperatures of 1150 K, 1250 K, and 1500 K at a pressure of 1 atm, with additional computations for pressures of 0.5 atm and 2 atm at an initial mixture temperature of 1250 K. This study suggests that although all the conditions for hydrogenburning hypersonic ramjet engine tests in a combustion-heated wind tunnel cannot be matched to clean-air flight conditions, the chemical kinetic effects of CO2 and H2O are small enough to allow useful interpretation of test results for initial temperatures of 1250 K or higher and pressures near 1 atm or less. Author

N70-23572# Deutsche Forschungs- und versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
A DEVICE FOR INTERMITTENT AND PULSATING COMBUSTION [EIN VERSUCHSGERAET FUER INTERMITTIERENDE UND PULSIERENDE VERBRENNUNG]
Kurt Gruemmer, Wolf Trommsdorff, and Guenter Zhuber-Okrog Nov. 1969 31 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-82) Avail: CFSTI

It is possible to have nearly isochoric combustion in the case of pulsating combustion in tubes with one open side. This report describes tests with a device for intermittent combustion which approaches isochoric combustion more closely in order to increase the pressure amplitudes. Construction of the device and its functions are described and the modifications of several components, necessary after the first test runs, are explained. The behavior of the modified device is described. Conditions for starting either intermittent or pulsating combustion were investigated. Parameters influencing the pressure amplitudes were studied and found to be the cross-section of the incoming air, the arrangement and design of the elements for fuel injection and flame stabilization, and the quantity of injected fuel per cycle. Author (ESRO)

N70-23647# National Bureau of Standards, Washington, D.C.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS, OCTOBER –DECEMBER 1969
J. J. Diamond, ed. Jan. 1970 87 p refs
(NBS-SP-315-4) Avail: SOD $0.75

The bibliography consists of references to research involving temperatures above 1000 C, which were noted by the Contributors during this period. This is intended primarily as a current-awareness bibliography. This issue contains about 775 references roughly grouped under fifteen subject headings. Author

N70-23813# Commissariat a l Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
FRICTION COEFFICIENTS IN SINGLE-PHASE GAS FLOW WITH HEAT TRANSFER [LE COEFFICIENT DE FROTTEMENT DANS UN ECOULEMENT TURBULENT EN SIMPLE PHASE AVEC TRANSFERT DE CHALEUR]
Jean Costa Dec. 1969 19 p refs In FRENCH; ENGLISH summary
(CEA-BIB-170) Avail: CFSTI

The different correlations of the f sub H/f sub iso ratio (friction coefficient with heat transfer divided by the isothermal friction coefficient) are reviewed and compared amongst themselves. There is found to be a dispersion of about 20 per cent on either side of the average value. Author (ESRO)

N70-23889*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATION IN GROUND-TEST FACILITIES OF ABLATION PERFORMANCE OF CHARRING ABLATORS DURING ATMOSPHERIC ENTRY
Stephen S. Tompkins Washington Apr. 1970 38 p refs
(NASA-TN-D-5769; L-6516) Avail: CFSTI CSCL 20M

An analytical and experimental investigation is presented to establish a technique by which the performance of charring ablators in high-enthalpy environments can be simulated in low-enthalpy einvironments. Relationships are presented which indicate that proper simulation can be achieved by adjusting the heat input and stream oxygen content in the low-enthalpy environment. The technique is subject to the assumption that diffusion-controlled oxidation is the only mechanism of char removal. Tests with two phenolic-nylon charring ablators were made at two enthalpy levels to validate the simulation technique. Nominal values of the principal test parameters for the two environments were as follows: For enthalpy, 10,000 and 3000 Btu/lbm; for cold-wall convective heating rates, 155 and 145 Btu/sq ft minus s; and for stream oxygen mass fractions, 0.23 and 0.05. A comparison of the ablation performance data indicates that satisfactory simulation was obtained. Author

N70-23900*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL STUDY OF BLADE-TYPE HELICAL FLOW INDUCERS IN A 5/8-INCH ELECTRICALLY HEATED BOILER TUBE
Nick J. Sekas and James R. Stone Washington Apr. 1970 17 p refs
(NASA-TM-X-2001; E-5524) Avail: CFSTI CSCL 20M

The effects of blade-type flow swirlers on maximum exit quality of a 5/8-inch (1.59-cm) boiler tube were investigated. Data were obtained for various swirler spacings at a mass flow rate of 400 lbm/hr. Measurements of mass flow rate, heat flux, inlet water temperatures and pressures, outlet vapor temperatures and pressures, and axial wall temperature distribution for each run were made and are presented in tabular form. The quality, pressure drop, and critical heat flux for the plain tube are compared with values for tubes containing various numbers and spacings of flow swirlers. It was found that maximum exit quality increases from 0.30 to

0.60 by adding five swirlers. At a 0.3 exit quality, the pressure drop of the tube with five swirlers is 58 percent greater than for the plain tube. Author

N70-23901# Naval Ordnance Lab., White Oak, Md.
INVESTIGATION OF SUBSTRUCTURE HEATING ON CRACKED ABLATIVE HEAT SHIELDS Final Report
Eva M. Winkler, Richard L. Humphrey, Joseph A. Koenig, and Michael T. Madden 22 Jul. 1969 40 p refs
(AD-699136; NOLTR-69-122) Avail: CFSTI CSCL 16/3

An experimental program was carried out to study the effect of cracks in an ablative heat shield on the substructure heating. The test conditions involved stagnation pressures of 20 to 30 atmospheres, temperatures of 4000 to 9000R, and Mach numbers of 2.3 and 3. The models, made of teflon, has transverse and longitudinal cracks machined into the surface. They were instrumented for pressure, temperature, heat transfer and skin-friction measurements. The cracks were found to have pronounced effects on the ablative behavior. The heating is moderate under a laminar boundary layer, but can be catastrophic when the boundary layer is turbulent, depending upon the size and direction of the crack. The results for the transverse cracks were compared with an available analytical prediction. Ablation was found to reduce the wall shear stress by 40 percent or more. Author (TAB)

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N70-22561# Kernforschungsanlage, Juelich (West Germany).
LITERATURE COLLECTIONS IN THE FIELD OF NUCLEAR SCIENCES [LITERATURZUSAMMENSTELLUNGEN AUS DEN GEBIETEN DER KERNWISSENSCHAFTEN]
1969 21 p refs In GERMAN
(Jul-Bibl-7) Avail: CFSTI

This collection enlarges the second edition of the Juel-bibliography-7 with 120 literature sources from the fields of: (1) mathematics; (2) physics; (3) chemistry; (4) technology; (5) isotope technology; (6) metals and other materials; (7) reactor technology; and (8) biology and medicine. An alphabetical index is provided. Transl. by G.G.

N70-22851*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-59, VOLUME 3 FOR THE PERIOD 1 AUGUST TO 30 SEPTEMBER, 1969. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
31 Oct. 1969 277 p refs
(Contract NAS7-100)
(NASA-CR-109288; JPL-SPS-37-59-Vol-3) Copyright. Avail: CFSTI CSCL 05B

Research and development activities reported cover the wide area from space sciences to telecommunication, guidance and control, engineering mechanics, and mission analysis. The technical information reviewed results from current scientific and engineering work. For individual titles, see N70-22852 through N70-22872.

N70-22862*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT POWER
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 90-127 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 10B

Examined are the following aspects of spacecraft power: (1) lightweight solar panels in combination with NiCd batteries for tracking and data relay satellite network; (2) design of heat sterilizable silver oxide-zinc battery; (3) heat generation measurements for Surveyor main battery by isothermal calorimeter with automatic read-out; (4) gravity effects on zinc electrode performance; (5) surface reactions during oxidation and reduction of alkaline silver electrode; (6) simulation of gamma ray spectrum and intensity from plutonium -238 source; (7) schielding requirements for radiation field around plutonium-236 source; (8) development of cylindrical thermionic energy converters operating on heat release from isotopic decay; (9) life endurance tests of lead-telluride multi-couple thermoelectric modules; (10) development of long life high-performance silver oxide-zinc battery; and (11) operational features and capabilities of radioisotope thermoelectric generator test laboratory. G.G.

N70-22865*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLIED MECHANICS
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 156-171 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 13M

Described is a multilayer-insulation thermal vacuum setup designed to evaluate degradation effects of thermal blankets for the Ranger and Mariner spacecrafts. A preliminary study of nonlinear coupled subsystems for the Mariner solar panel system shows that nonlinear effects in a structural system are caused by nonlinear coupling units that can be determined by the receptance method. A standard for the Mariner Mars temperature control flux monitor is established; set point temperature, aperture area, and the amount of electrical power in single power bids are calibrated so that the remaining variable width of the power pulse to the cone heater is the number of power bits. The receptance coupling computer program is extended to treat random nonstationary phenomena as well. G.G.

N70-22870*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH AND ADVANCED CONCEPTS
In its Space Programs Sum. No. 37-59, Vol. 3 31 Oct. 1969 p 205-233 refs (See N70-22851 10-34)
Copyright. Avail: CFSTI CSCL 10A

The performance evaluation of a hollow cathode ion thruster showed that throttling at constant propellant utilization over a 2:1 range of output power can be achieved with small penalties in total thruster operating efficiency. The effects of one dimensional heat transfer on diode thermionic performance were established by plotting variations in net efficiency and power density versus average output current density. Erratic operation and power conditioning unit combination was attributed to impurities in the mercury vapor of the electron bombardment ion thruster. An impinging jet separator was used to increase the cesium-lithium cycle efficiency of a magnetohydrodynamic power conversion system by 1 to 3 percentage points. A preliminary design study indicated that it is feasible to control the cesium reservoir temperature and to maintain a high conversion efficiency over a range of diode operating states in thermionic reactor systems. Experimental heat transfer results for ionized gas flow over a segmented flat surface established that the origin of the thermal boundary layer occurred at a distance of about 0.8 of the segment length from the leading edge of the upstream segment. G.G.

N70-22982# General Electric Co., Philadelphia, Pa. Space Div.
NEW DIMENSIONS IN PROJECT PLANNING AND CONTROL
James R. Polski and Roy W. Eston Oct. 1969 32 p refs Presented at the 2d Intern. Congr. on Proj. Planning by Network Analysis, Amsterdam, 7 Oct. 1969
(PB-186499) Avail: CFSTI CSCL 05A

The discussion is chiefly concerned with schedule and resource planning, and the measurement aspects which lead to control, as well as the communications vital to accomplishing this. It is treated in the context of the design, development, and acquisition phases of the project life cycle. Author (USGRDR)

N70-23065# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
METHODS OF COMMUNICATION ABOUT PREVENTIVE ACTION: THE STRATEGY OF STRESS CORROSION CRACKING PREVENTION
R. J. Schliekelman *In* AGARD Eng. Pract. to Avoid Stress Corrosion Cracking Feb. 1970 7 p (See N70-23061 10-17)
Avail: CFSTI

Stress corrosion cracking cannot be prevented by only studying the theoretical backgrounds of it. A well organized system of communication is required in order to guarantee that all factors, that play a role in stress corrosion cracking, receive the required attention during the proper phase of the complete chain of activities from design through production to the operation of the aircraft. The feedback of service experience is considered as vital for the success of the action. A diagram is given, showing the flow of information to the personnel concerned. Author

N70-23076# Advisory Group for Aerospace Research and Development, Paris (France).
PROBLEMS IN MECHANIZATION OF SMALL INFORMATION CENTRES
J. J. Irvine, comp. Feb. 1970 135 p refs Presented at the Specialist Meeting of the Tech. Inform. Panel of AGARD, Ottawa, 16 – 17 Sep. 1969
(AGARD-CP-57) Avail: CFSTI

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12. SUMMING-UP OF THE SPECIALIST MEETING M. S. Day (NASA) p 115–117 (See N70-23088 10-34)

N70-23077# Defence Research Board, Ottawa (Ontario). Defence Scientific Information Services.
OBTAINING MANAGEMENT ACCEPTANCE OF A SYSTEM PROPOSAL
A. C. Jones *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 1–5 (See N70-23076 10-34)
Avail: CFSTI

The paper suggests the steps necessary to prepare an automated information retrieval system proposal, to obtain data for justification of the proposal and to present it for final approval. The need is stated for the information centre to be itself convinced that it has the best proposal to offer, before it can expect to receive approval. The higher management may need to be shown what the information centre has been doing and what its customers want, before examining the new proposal. The paper touches on the difficult question of evaluating any information system, but emphasizes the impracticability of retaining a manual system when the raw material for processing is going to be provided in machineable form. Finally, it urges a team approach to preparing and presenting the proposal, and holding the team together for follow-up on points requiring further resolution. Author

N70-23079# European Space Research Organization, Paris (France). Documentation and Library Service.
THE USER AND THE AUTOMATED SYSTEM IN A EUROPEAN ENVIRONMENT
N. E. C. Isotta *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 27–34 refs (See N70-23076 10-34)
Avail: CFSTI

The paper briefly outlines the early history and development of the ESRO/ELDO Space Documentation Service. The installation of the new direct access remote console system (NASA/RECON) is described. The necessity, and difficulty of talking to the multilingual European user is emphasised. Cost considerations are mentioned together with the user's requirements in this request. The current feasibility and design study for the creation of a databank on electronic components and materials is outlined. The possibility of inter-disciplinary international direct access computer systems is suggested. Author

N70-23080# National Library of Medicine, Bethesda, Md. Lister Hall National Center for Biomedical Communications.
PREPARING THE ORGANIZATION FOR AUTOMATION
Davis B. McCarn *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 35–41 refs (See N70-23076 10-34)
Avail: CFSTI

Careful planning and tactful action to ready the organization are critical to the success of automation. In spite of the obviousness of this platitude many egregious system failures have resulted from unrecognized organizational resistance. The assault of the system analysts and programmers is often either naive or machiavellian; naive when it assumes that computer technology is the wave of the future and no rational employee could object to the new system; machiavellian when technology is used as a pretext to wrest control of the organization's information network and, thus, control of the organization itself. To facilitate an effective automation, management must recognize these potentials for conflict; act to resolve those which develop; develop and maintain a climate hospitable to change; involve personnel throughout the organization in system design and development; recognize and act to reduce unrealistic uncertainties and fears; control the enthusiams of the technologists; and insure that employees are trained to accept new ways and new roles. Author

N70-23081# Department of National Defence, Ottawa (Ontario).
FINDING THE OPTIMUM MIX OF STAFF AND CONSULTANTS
G. X. Amey *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 43–49 refs (See N70-23076 10-34)
Avail: CFSTI

The problem of staffing an information service during the transition from the manual to an automated system is analyzed.

The stages of development are presented in detail so as to indicate the reeducation of all levels of staff as they begin to realize the pay-offs possible from such a system and the demands it will make of its exploitars if the possibilities are to be realized. Of the development strategies possible, DSIS chose to emphasize that in which the work is carried out cooperatively between the internal staff and consultants external to the organization. This helps to minimize difficulties with internal staff, by ensuring their involvement at all times so that they feel the system being developed is their own. To optimize the man-machine system it is necessary to restructure the organization to make best use of the special qualities of each of the principal elements. Methods are practical in small manual systems in which there are no true specialists and everyone does a little of everything. This approach must be rationalized during automation to ensure that there are no weak links in the system. Author

N70-23083# European Atomic Energy Community, Luxembourg. Technical and Scientific Documentation Centre.

THE INFLUENCE OF SYSTEM DESIGN ON SYSTEM QUALITY AND ECONOMY

Rudolf Bree *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 67–72 (See N70-23076 10-34)
Avail: CFSTI

System's design for mechanized information services must try and aim at a reasonable balance between the quality of the service offered and the operational economy in rendering services. Considerations in input operations, subject control, structurization of the vocabulary used in the system and on output-forms are discussed in respect to their effect on quality and operational economy. The experience gained during the development and the operation of the nuclear documentation system of the European Community served as basis for the presentation. Author

N70-23084# National Science Library of Canada, Ottawa (Ontario).

PROBLEMS OF INPUTTING DATA FROM OTHER SYSTEMS

Jack E. Brown *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 73–78 (See N70-23076 10-34)
Avail: CFSTI

The computerized techniques of the National Science Library of Canada for facilitating the handling of the information from various information systems are discussed. The formats developed for overcoming the incompatibility of tape services are included. At present, subscribers to the library are shown to have access to three tape services: chemical titles, chemical abstract condensates, and ISI source tapes. F.O.S.

N70-23085# Advisory Group for Aerospace Research and Development, Paris (France).

RETRAINING OF PERSONNEL TO FIT INTO AUTOMATED SYSTEM

J. H. Klopp *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 79–85 (See N70-23076 10-34)
Avail: CFSTI

Criteria to be considered before introducing computerized information retrieval service(s) are analyzed. Special attention is devoted to decision taking in switching to an automated system and to the training of the personnel including directors and senior staff. Author

N70-23086# European Atomic Energy Community, Luxembourg.

RE-EDUCATING USERS TO AUTOMATED SYSTEMS

Carlo. Vernimb *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 87–100 (See N70-23076 10-34)
Avail: CFSTI

Computerized documentation systems using coordinate indexing and retrieval which require precise query formulations are discussed. Users' comments are indispensable for evaluating the efficiency of the system. A feedback formsheet is presented, and an example of feedback given. Author

N70-23087# Oak Ridge National Lab., Tenn. Nuclear Safety Information Center.

EVALUATION AND COST ANALYSIS OF COMPUTERIZED INFORMATION ANALYSIS CENTER OPERATIONS

J. R. Buchanan *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 101–113 refs (See N70-23076 10-34)
Avail: CFSTI

A discussion is presented of how computerization can enable an intermediate-size information analysis center (2,000 to 12,000 accessions per year) to most efficiently use its professional and clerical staff and to prepare for growth. In order to make effective use of its funds and prepare for expansion or increased scope, it is important to plan ahead for the collection of operating data that will permit cost analysis of the various production operations connected with collecting, processing, and outputting the services offered. Measurement of user response and effectiveness of the services are vital to this analysis. The experience of the Nuclear Safety Information Center and other information analysis centers are used to illustrate how this has been done. Author

N70-23088*# National Aeronautics and Space Administration, Washington, D.C.

SUMMING-UP OF THE SPECIALIST MEETING

Melvin S. Day *In* AGARD Probl. in Mechanization of Small Inform. Centres Feb. 1970 p 115–117 (See N70-23076 10-34)
Avail: CFSTI CSCL 05B

Highlights of the presentations are summarized. Continuous advances in computer capabilities, sources of input to the automated systems, availability of full text of original documents, selling top management on the need for a computerized system, difficulties of training users to benefit from the new system, and system management are mentioned. The combination of practicality and common sense in meeting problems of mechanizing an information center is considered of primary importance. F.O.S.

N70-23324*# George Washington Univ., Washington, D.C.

THE APOLLO DECISION AND ITS LESSONS FOR POLICY-MAKERS

John M. Logsdon (Catholic Univ.) Jan. 1970 39 p refs *Its* Occasional Paper No. 7
(Grant NGL-09-010-030)
(NASA-CR-109284) Avail: CFSTI CSCL 05H

Political processes leading to the U.S. decision to place men on the moon are discussed. An analysis is made of the far-reaching effects of this decision on future governmental efforts to deal with external and domestic challenges. The feasibility of employing the successful techniques of organizing and directing energy used in Project Apollo for other worthwhile societal objectives is evaluated. D.L.G.

N70-23391# Advisory Group for Aerospace Research and Development, Paris (France).

FIFTH AGARD ANNUAL MEETING

Sep. 1969 38 p Conf. held in Bad Godesberg, West Ger., 11–12 Sep. 1969
Avail: CFSTI

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2. RESEARCH IN "FLUGFUEHRUNG" K. H. Doetsch (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, W. Ger.) p 13–22 (See N70-23393 10-21)

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5. ADDRESS BY DOCTOR GUNNAR RANDERS G. Randers p 30–31 (See N70-23396 10-34)

6. THE APOLLO 11 MISSION C. M. Lee (NASA, Washington, D.C.) p 33–35 (See N70-23397 10-30)

N70-23392# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Bad Godesberg (West Germany).

SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT IN THE FEDERAL REPUBLIC OF GERMANY

Theodor Benecke *In* AGARD 5th AGARD Ann. Meeting Sep. 1969 p 10–12 (See N70-23391 10-34)
Avail: CFSTI

The organization, functions, and activities of the German Aerospace Research and Testing Institution are described. Activities in the field of aeronautics are outlined, and include the following: short takeoff and landing, supersonic flight, vertical takeoff and landing, load recovery systems, flight control, all-weather navigation electronic equipment, aviation fuels, strength and construction techniques, materials behavior in space, factors affecting weather forecasting, aviation medicine, and air breathing, chemical, and electric propulsion systems. N.E.N.

N70-23394# Messerschmitt-Boelkow G.m.b.H., Munich (West Germany).

INDUSTRY AND RESEARCH AS DEMONSTRATED IN THE FIELD OF AEROSPACE TECHNOLOGY

J. Henrici *In* AGARD 5th AGARD Ann. Meeting Sep. 1969 p 23–26 (See N70-23391 10-34)
Avail: CFSTI

The development of cooperation between German research institutes, commercial industries, and government in the field of aerospace technology is described. Emphasis is placed on the need for communication and transmission of information, not only within a nation but internationally. Consideration is also given to the teaching of space technology and science. N.E.N.

N70-23395# Advisory Group for Aerospace Research and Development, Paris (France). International Military Staff.

ADDRESS BY LIEUTENANT GENERAL THEODORE R. MILTON

Theodore R. Milton (AF) *In its* 5th AGARD Ann. Meeting Sep. 1969 p 28–29 (See N70-23391 10-34)
Avail: CFSTI

The aviation technology of 1949 is briefly compared to that of 1969, and appreciation is expressed for the contributions of AGARD to NATO. The spectacular performance of the V/STOL Harrier and air to air ordnance are mentioned. N.E.N.

N70-23396# Advisory Group for Aerospace Research and Development, Paris (France). Scientific Affairs Div.

ADDRESS BY DOCTOR GUNNAR RANDERS

Gunnar Randers *In its* 5th AGARD Ann. Meeting Sep. 1969 p 30–31 (See N70-23391 10-34)
Avail: CFSTI

The program of the Scientific Affairs Division of NATO are described. The classical program contributes fellowships for young scientists to do postgraduate studies, provides institutes for specialists in particular fields, and gives research grants to scientists in fields considered important for the alliance. New projects, which are supported by the research grants, are identified as computer software, air/sea interactions, and stress corrosion problems. The preparation is mentioned for forming a committee on Challenges of Modern Society, which will investigate the use of NATO to induce member countries to take actions on problems such as pollution, traffic congestion, and city crime. N.E.N.

N70-23551# European Space Research Organization, Paris (France).

BASIC TEXTS, RULES AND REGULATIONS, AND AGREEMENTS OF THE EUROPEAN SPACE RESEARCH ORGANIZATION

Mar. 1969 385 p
(ESRO-SP-4) Avail: CFSTI

The convention for the establishment of a European Space Research Organization (ESRO) together with various financial protocols are printed in this collection of ESRO basic texts. The rules include the procedural ones for the Scientific and Technical Committee and the Administrative and Financial Committee, along with the financial rules, staff rules, and general conditions for ESRO contracts. The agreements mainly concern the establishment of rocket ranges, tracking equipment, etc., in various European and other countries and the Memorandum of Understanding between ESRO and the NASA concerning the furnishing of satellite launching and associated services. ESRO

N70-23582# Technische Univ., Berlin (West Germany). Inst. fuer Raumfahrttechnik.

ON THE BENEFIT OF SPACE RESEARCH SEEN FROM THE GERMAN POINT OF VIEW: A MACRO-MODEL FOR EVALUATING THE ORDER OF MAGNITUDE OF SPACE RESEARCH BENEFIT FOR THE FEDERAL REPUBLIC OF GERMANY [UEBER DEN NUTZEN DER WELTRAUMFORSCHUNG AUS DEUTSCHER SICHT: EIN MAKRO-MODELL FUER DIE ABSCHAETZUNG DER GROESSENORDNUNG DES AUS DER WELTRAUMFORSCHUNG ABLEITBAREN NUTZENS FUER DIE BRD]

31 May 1968 68 p In GERMAN; ENGLISH summary
(TUB-IR-4-68) Avail: CFSTI

A macro-model is described for the determination of the order of magnitude of the observed and potential benefits which can be derived from space research activities for the German Federal Republic. Preliminary estimates indicate an economic benefit of the order of 2.5 billion dollars for the year 1985. The scientific and political benefits will have to be added to this and can easily double this figure. More than 500 individuals contributed to this basic model by making information available in those areas in which benefits were observed or are expected in the future. Additional studies are required before a reasonable picture can be obtained concerning the cost-effectiveness of space activities from the viewpoint of the German Federal Republic. Author (ESRO)

N70-23621# Radio and Space Research Station, Slough (England).

WORLD DATA CENTRE, C ROCKETS AND SATELLITES: LIST OF REPORTS AND REPRINTS, 1 JULY–31 DECEMBER 1969

31 Dec. 1969 11 p refs
Avail: CFSTI

This brief bibliography lists reports and reprints of rocket and satellite research studies and flight operations from the World Data Center. Publications cover the period 1 July through 31 December, 1969. G.G.

N70-23652# National Bureau of Standards, Washington, D.C.

REPORT OF THE 54TH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES 1968

R. L. Koeser, ed. Nov. 1969 270 p refs Conf. Held at Washington, D.C., 9-13 Jun. 1969 *Its* Special Publication No. 318
Avail: SOD $2.50

The proceedings of the fifty-fourth national conference on weights and measures held June 9-13, 1969. State, county, and city weights and measures officials and representatives of the federal government, business, industry, railroads, and associations attended. Author

N70-23699# Maschinenfabrik Augsburg-Nurnberg A. G., Munich (West Germany). Bereich Fortschrittliche Technologie.

A NEW ECONOMIC CONCEPT FOR EUROPEAN SATELLITE LAUNCH VEHICLE SYSTEMS [EIN NEUES

WIRTSCHAFTLICHES KONZEPT FUER EUROPAEISCHE SATELLITENTRAEGERSYSTEME]

M. Simon and J. Feustel 1969 47 p In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
(Rept-10) Avail: CFSTI

A new concept for future launch rockets for the years 1970–1980 involving cost optimization and other economic viewpoints, is described. Based on extensive computer programs for performance calculation and cost models, it is made clear that the originally planned launch vehicle EUROPA 4, with highly energetic upper stages is uneconomical. A new, economically optimal, design of the three stages is proposed and it is shown that, for a final choice, the launcher and satellite program should be optimized as a whole. Finally, the concept of the further usability of launch vehicles in the years ahead is seen as economically viable. ESRO

N70-23793# National Academy of Sciences-National Research Council, Washington, D.C.

TECHNOLOGY: PROCESSES OF ASSESSMENT AND CHOICE

Jul. 1969 174 p refs
Avail: SOD $2.50

Technology assessment problems are examined primarily in terms of technological trends themselves and secondarily on the individual effects of such trends on society and the environment. Critical deficiencies in assessment and decision making processes are identified with the aim of ensuring that technology development will reflect greater sensitivity to the total systems effect on the human environment. The creation of a federal agency is proposed to coordinate private and public technology assessment systems and act as an institutional basis for expediting further research in this area. E.M.C.

N70-23801# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatisme et de ses Applications Spatiales.

RESEARCH PROGRAM ON AUTOMATION: APPLICATIONS TO CHEMICAL ENGINEERING [LA RECHERCHE CONCERTEE EN AUTOMATIQUE: APPLICATIONS AU GENIE CHIMIQUE]

Jean Lagasse [1968] 23 p In FRENCH Presented at the Intern. Days on Chem. Engineering, Paris, 27-30 May 1968
(LAAS-522) Avail: CFSTI

This report concerns automation in fuel chemical engineering. It deals with a pilot plant for the catalytic upgrading of the octane number of gasoline for which a mathematical model was developed. Feedback parameters for the control of the reaction are also discussed. ESRO

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